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THE UNIVERSITY OF ALBERTA
AN EVALUATION OF THE ROLE OF
PHYSICAL FACTORS IN THE UTILIZATION OF LAND USE
IN THE BOY RIVER VALLEY IN CANADA

By
JOHN STELLA GUNDEL

A THESIS
SUBMITTED TO THE FACULTY OF GRADUATE STUDIES
IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE
OF MASTER OF ARTS

DEPARTMENT OF GEOGRAPHY

EDMONTON, ALBERTA

CANADA, 1965

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UNIVERSITY OF ALBERTA
FACULTY OF GRADUATE STUDIES

The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies for acceptance a thesis entitled An Evaluation of the Role of Physical Factors in the Evolution of Land Use in the Bow River Valley in Calgary, submitted by John Steele Gibson in partial fulfilment of the requirements for the degree of Master of Arts.

Date

March 1, 1965

ABSTRACT

This study was conducted in an attempt to evaluate the role of physical factors in the evolution of land use in the valley of the Bow River within Calgary. A major aim of the research was to trace the evolution of land use in the study area from the establishment of the settlement in 1875 until the present.

The major characteristics of slope, water supply and surficial deposits were examined for their role in facilitating or restricting urban development. The Bow River is subject to flooding and this has affected land use in the vicinity of the channel. Slope instability is an important problem for development in one section of the study area. Railway facilities have been provided on the gentle slopes of the valley flats and have played an important role in the evolution of industrial and commercial land use.

Industry and recreation and open space have been affected to a greater extent by the physical character of the valley than any other elements of the land use pattern. Industrial location questionnaires were used to determine the major physical and economic benefits accruing from a site in the study area.

Physical factors have exercised greater influence indirectly through the transportation pattern than by their direct effect on land use. It has been recognised, however, that many other factors, other than physical factors have combined to influence the development of land use.

ACKNOWLEDGEMENTS

The author would like to thank many people in Calgary who helped him during the preparation of this thesis. In particular, he is grateful to Mr. A. G. Martin, Chief Planner and Mr. J. Eastwell, Research Planner, of the Planning Department of the City of Calgary and to Mr. K. Ford, Director of the Department of Industrial Development of the City of Calgary. Acknowledgement is also made of the initial help and suggestions offered by the staff of the Department of Geography, University of Alberta, Calgary.

To all those industrialists and businessmen who freely gave of their time to answer the questionnaires, the author's thanks are due.

Special acknowledgement is due Dr. P. J. Smith, of the Department of Geography, University of Alberta, Edmonton, who supervised the thesis, for his careful and invaluable criticism of the manuscript. Finally, the author is grateful to Mrs. Marion Svendsen for so competently typing his thesis.

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* By courtesy of Calgary Power Ltd.

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CHAPTER I

INTRODUCTION

The most distinctive physiographic unit within the present boundaries of the city of Calgary is undoubtedly the valley of the Bow River. Although restricted in width towards the northwest and southeast, the steep-walled, flat-bottomed valley opens out in the heart of the city and has been the nucleus of urban development since the first settlement was established in 1875. It is the purpose of this thesis to study the evolution of land use in this area and to evaluate the role of physical factors in fashioning the present pattern. The balance between physical and other determinants of land use will be a recurring theme for it is recognised that the former alone have seldom exercised a controlling influence on land use. Although attention throughout will be focussed on land use in the valley, overall urban development will be borne in mind, for the latter has frequently depended on conditions in the study area.

In this thesis the physical characteristics of the river valley are held to embrace,

- (1) the degree, location and regularity of slope,
- (2) the availability of river water and groundwater supplies,
- (3) the type of surficial deposit,
- (4) the susceptibility of the Bow River to flood,

- (5) the susceptibility of steep or undercut slopes to mass movement,
- (6) the form of the river valley as a contributing factor in air pollution.

The area under study may be defined as lying between the major continuous bluffs on each side of the Bow River within Calgary (see Fig. 1). This delimitation includes those islands of elevated plateau country which are a characteristic of the valley particularly in southeast Calgary (see Fig. 2). These plateaux have resulted from dissection by shifting stream channels associated with the development of the present drainage pattern. Today, therefore, the physiography over much of the study area consists of patches of flat land isolated from each other by former stream channels.

To the newly arrived immigrant of today as well as to the early explorers, the valley of the Bow River at Calgary would appear to be unique among the river valleys of Western Canada. This unicity stems from the incision of the forerunners of the Bow River and the development of extensive valley flats. The contention behind the present investigation is that the nature of the valley influenced urban development, at least in the past if not still today. It must be stressed that no defence of any type of environmentalism is implied by the concentration on the physical nature of the study area. Rather it is felt that the river valley offered possibilities for development, some more and some less reasonable than those associated

CALGARY AND THE STUDY AREA

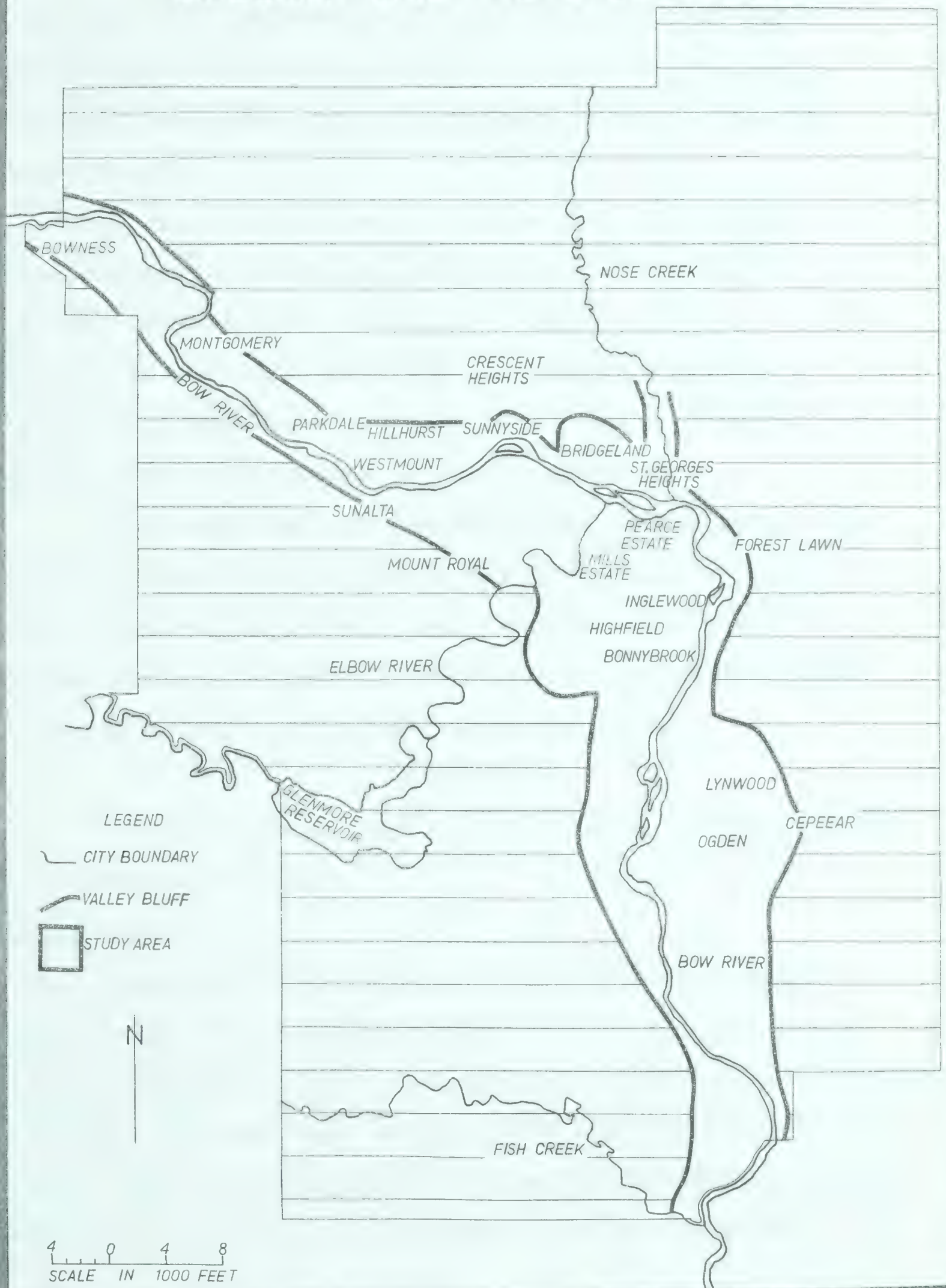


Fig. 1. Source: Calgary, City Planning Department

with any other environment in the vicinity of Calgary. Land use is an expression of the interaction of many forces but the present research is aimed at evaluating the relative importance of physical factors in the Bow River valley.

It is also necessary to note from the outset how time may have modified or changed the attributes of the valley for particular land uses. Especially has this been evident in industry where the increased popularity of trucking as opposed to rail haulage has had repercussions on the site requirements of many industries.

Although the land use data used in the compilation of this thesis are similar to those commonly analysed in urban studies, it is felt that their treatment and interpretation is somewhat different due to the emphasis given to physical factors in land use evolution.

METHODOLOGY

The approaches used in the solution of the problem are summarised below.

Literature

Land use literature generally lacks a detailed appreciation of how physical factors can influence urban land use either directly, or indirectly through transportation control. One pertinent aspect which has received attention in recent years is that of flooding and flood damage. In the section that follows, literature will be discussed

under three headings: (1) town planning and geographical works; (2) material relating to the study area and the city of Calgary; and (3) material on such relevant physical problems as flooding.

(1) Town Planning and Geographical Works

In arriving at the right and balanced allocation of land among the various urban space using functions, town planners emphasize the non-physical determinants of land use such as economic, social and public interest values.¹ Established works by Chapin and Keeble give little discussion of the importance of physical factors in land use planning.² Local planning authorities, however, are more aware of the physical practicalities of a given site and their reports usually include some treatment of the local physiography.³ Cities plagued by a particular physical problem such as flooding afford these problems detailed treatment in their planning reports.⁴

Geographical works dealing with land use lay greater emphasis on the role of the physical environment as a land use control. This is especially true of studies dealing

¹ F. S. Chapin, Urban Land Use Planning, New York, 1957, 397 pp.

² L. Keeble, Principles and Practice of Town and Country Planning, Second Edition, London, 1959, 338 pp.

³ See for example, Metro Growth Plan, Inter-County Regional Planning Commission, Master Plan, Report No. 16, Denver, Colorado, 1960, 66 pp.

⁴ For example, Comprehensive Plan Tulsa Metropolitan Area, Tulsa Metropolitan Area Planning Commission, Tulsa, 1960.

with large areas where variations in physiography and climate influence land use.⁵ In these works and others, however, little mention is made of the availability of developable land with regard to the detailed physical environment as this affects such matters as the provision and extension of water and sewerage utility systems. Urban land use is currently receiving increased attention as the fields of urban geography diversify and become more specialised.

(2) Study Area Material

Little material directly relevant to the study area is available although the city of Calgary is well documented.

Early writing on Calgary lacked a scientific and objective approach and seems to have been essentially concerned with presenting as favorable a picture as possible of the city's prospects. This attitude is apparent in such works as Calgary⁶ and the early plan for the future development of the city produced by Mawson in 1914.⁷ The former work was prepared to entice emigrants

⁵ J. W. Maxwell, "Agricultural Land Utilization in the Dixonville-Fort Vermilion Area of Alberta, Geographical Bulletin, No. 21, Geographical Branch, Department of Mines and Technical Surveys, Ottawa, May, 1964, pp. 93-122.

⁶ S. L. Bensusan (ed.), Calgary, London, 1911, 88 pp.

⁷ T. H. Mawson, The City of Calgary, Past, Present and Future, London, 1914, 88 pp.

from the British Isles to the rapidly growing community and paints a very romantic picture of the opportunities. The most useful of all the early sources proved to be the files of the two newspapers, 'The Calgary Herald' and 'The Albertan', early editions of which were available on microfilm. The only academic treatise dealing with the early history of the settlement was an M. A. thesis tracing development from the earliest times until the turn of the century.⁸

In recent years the City of Calgary Planning Department has produced studies which were of considerable significance in that they presented the only available statistical account of the urban land use pattern.⁹ This information proved to be a major source for the discussion of land use in Chapter III. However, the above material made little reference to physical factors in the development of land use and a major purpose of the research was to re-interpret the data in the light of the purpose of this thesis.

Two geological publications deserve mention here as they provided background on the evolution of the physiography of the study area. Tharin investigated the glacial history and Pleistocene stratigraphy of the Calgary area and also paid attention to the development of

⁸ L. H. Bussard, Early History of Calgary, unpublished M. A. thesis, University of Alberta, Edmonton, 1935, 135 pp.

⁹ See bibliography under the heading 'Calgary, City Planning Department'.

the present drainage pattern.¹⁰ Meyboom analysed the groundwater resources of the thick gravel deposits along the Bow River and concluded that these contained excellent reservoirs of water suited to domestic and industrial purposes.¹¹ Landslides and soil creep were also studied and it was concluded that groundwater played an important role in their promotion.

(3) Physical Problems of Development

The one physical problem with greatest pertinence to the present study is flooding. Calgary has a history of flooding stretching back to 1884 but accurate accounts of the extent and severity of damage are scarce. In recent years the flood question has been looked at afresh partially with a view to floodplain zoning.^{12,13} The whole question of floodplain development has been studied in the United States through the University of Chicago.¹⁴ Table I presents the results of an analysis of 732 floodplain communities in the United States and should be borne in

¹⁰ J. C. Tharin, Glacial Geology of the Calgary Area, unpublished Ph.D. thesis, University of Illinois, Urbana, 1960, 127 pp.

¹¹ P. Meyboom, Groundwater Resources of the City of Calgary and Vicinity, Research Council of Alberta, Bulletin 8, Edmonton, 1961, 72pp.

¹² Submission of Calgary Power Ltd. to the Royal Commission Inquiring into Ice Conditions on the Bow River, Calgary Power Ltd., Calgary, 1952.

¹³ Pers. comm., A. G. Martin, Chief Planner, City Planning Department, Calgary, 1963.

¹⁴ See Bibliography under 'White, G. F.'

mind for the discussion of land use in the study area contained in Chapter III. Other physical development problems such as air pollution have an extensive bibliography but are not relevant to the present study.

TABLE I
LAND USE ON URBANISED FLOODPLAINS

URBAN USE	NO. OF INSTANCES
Industries	299
Central Business Uses	281
Key Transportation Facilities	206
Peripheral Areas only	239
Entire Urban Area	110

Source: G. F. White, Ed.: Changes in Urban Occupance of Floodplains in the United States, Department of Geography, Research Paper No. 57, University of Chicago, Chicago, 1958, p. 45

Field Work: The major part of the field work was carried out during the summer and fall of 1963. This consisted of the inspection and mapping of the urban land uses on base sheets of a scale of 1 : 4800¹⁵ Land use recording in the most densely built up sections of the valley was carried out on foot. Much of the remaining, less intensively developed areas could be adequately surveyed using a 'windshield' type of approach. No attempt was made to record uses above the ground floor where a different use was involved as it was felt that these could in no way be

¹⁵ For discussion of the nature and number of categories used in mapping see Chapter III.

directly explained by the physical characteristics of the study area.

Questionnaires and Interviews: Industry is one of the most important land uses concentrated in the study area. Questionnaires were used to determine the influence of physical factors in the development of the industrial land use pattern.¹⁶ When useful questionnaires were returned attempts were made to glean more specific information by personal communication with the source.

LIMITATIONS OF STUDY

As research progressed it was found that certain proposed methods of investigation would not be feasible due to the amount of time required for their completion. Some of these would appear to offer rewarding avenues for research in their own right.

In order to describe the evolution of the land use pattern it was initially proposed to construct land use maps for selected past years. The land use classification for these historical maps would have been similar insofar as possible to that adopted for the 1963 field survey. By using Henderson's Street Directory of Calgary, land use for 1904 was plotted but, as the owners and occupiers were listed alphabetically, it was necessary to spend considerable time in locating and recording each address. To have

completed this approach for other years would have necessitated a vast amount of time. Because of this, as well as the fact that land use development was already well known from other historical sources,¹⁷ it was decided that the proposed mapping would not be warranted.

Flooding as a physical problem of development in the river valley could not be given the degree of recognition originally proposed due to a severe lack of records. Particularly promising would be the technique of using old photographs to plot flood limits and this has been attempted within the limits dictated by their availability. A detailed analysis of alluvial deposits in the vicinity of the river channel would do much to determine accurately those areas most susceptible to inundation.

PRESENTATION

The results of the present research will be presented as follows:

- Chapter I Introduction.
- Chapter II Physical Characteristics and Associated Problems of the Study Area.
- Chapter III Land Use.
 - A. The Evolution of Land Use and Transportation Patterns in the Study Area.
 - B. A Description and Analysis of the Present Land Use Pattern.
- Chapter IV Industrial Questionnaire Analysis.
- Chapter V Conclusions.

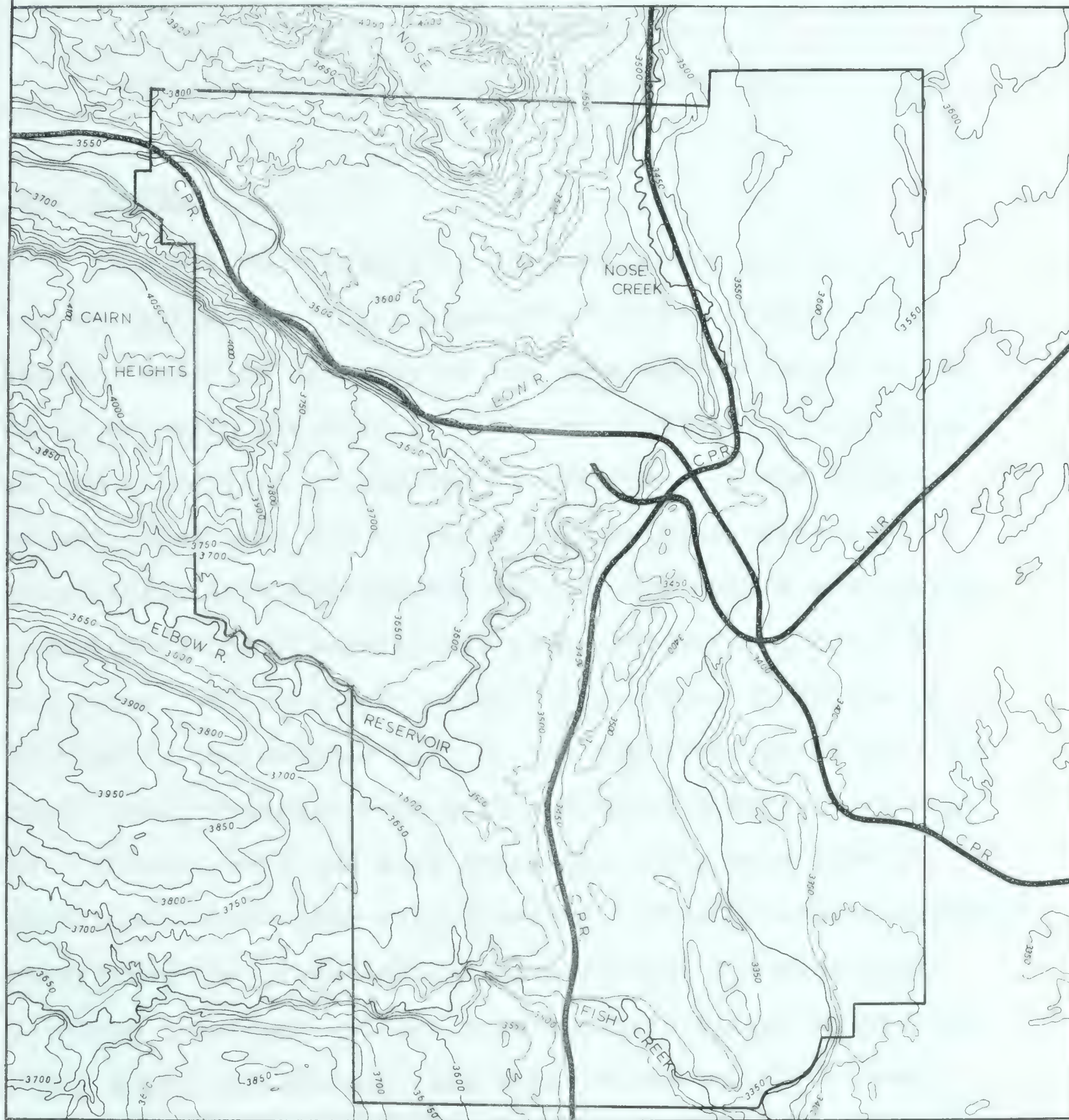
¹⁷

For example, Bussard. op.cit., p. 153




'The Calgary Herald' newspaper files, 1900-1962.

The Glenbow Foundation, Calgary.

PHYSIOGRAPHY AND RAILWAYS



LEGEND

-  RAILWAYS
-  CITY BOUNDARY
-  RIVERS

1 0 1 2 3
SCALE IN MILES

N

CONTOUR INTERVAL 50 FEET

Fig. 2. Source: Canada, Dept. of Mines and Technical Surveys

CHAPTER II
PHYSICAL CHARACTERISTICS
AND ASSOCIATED PROBLEMS OF THE STUDY AREA

Introduction

The city of Calgary is located at the confluence of the Bow and Elbow rivers where the rolling plains of the Western Prairies give way to the more varied relief of the Rocky Mountain foothills. Although initially established on the floodplain of the Bow River, the city has expanded in recent years over the surrounding irregular terrain. The most distinctive physiographical feature within the city is undoubtedly the steep-walled, flat-bottomed valley of the Bow River. In northwest Calgary the valley flats are restricted to the meander belt of the Bow River as it cuts a deep trough between Nose Hill and Cairn Heights (see Fig. 2). To the south and east these flats are extensively developed on the more easily eroded till and outwash deposits underlying the area. As is shown on Fig. 2, three flat-bottomed tributary valleys join the main valley within the study area: Nose Creek, the Elbow River and Fish Creek.

In the discussion that follows the physical characteristics of the study area will be treated under the headings outlined in Chapter I.¹

¹ See page 1.

Slope

Fig. 1 depicts the continuous valley bluffs which are everywhere easily distinguishable on each side of the Bow River. These major breaks of slope constitute the boundaries of the study area and have resulted from incision associated with the development of the present drainage system. Over much of the area they are too steep to be built upon and slopes in excess of 30 per cent are common towards the northwest. East of the Elbow River junction, however, the degree of slope diminishes and urban encroachment has taken place in some localities such as northeast Bridgeland and the Mills Estate (see Plate 1).

The study area is characterised by gentle slopes so that the surface is flat or gently undulating. Some terraces do occur, however, especially near the river channel, but their local relief is seldom in excess of ten feet. These have ^{probably} resulted from accelerated periods of local down-cutting and, although of minor importance for urban development, could be limiting criteria in the designation of flood hazard zones.² Within the study area the valley slopes from northwest to southeast. The decrease in altitude is about 200 feet, from 3,460 to 3,260 feet where the river leaves the area in the southeast.

To the east of the Elbow River there exists a complex system of entrenched river valleys and abandoned stream

² Pers. comm., H. McCollister, Water Engineer, City Engineering Department, Calgary, 1964.

The first part of the paper discusses the importance of the
theoretical framework in the study of the
relationship between the variables. The second part
presents the empirical results of the study. The third part
discusses the implications of the findings for the
theory and practice. The fourth part concludes the paper.

The results of the study show that there is a significant
positive relationship between the variables. This finding
is consistent with the theoretical framework. The
implications of the findings for the theory and practice
are discussed. The study has several limitations and
future research is suggested. The study is a
contribution to the literature on the relationship between
the variables.

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channels.³ These drained the former Lake Calgary towards the south and southeast and gave rise to much localised stream erosion in this area. The results of this process are manifest today in a broken topography with isolated islands of higher land located within the confines of the Bow Valley. Although rising some eighty to one hundred feet above the general level of the valley flat, they are held to comprise integral parts of the study area as they have been entirely detached from the surrounding till and outwash plains. Having little local relief their summits are reminiscent of the valley flats.

It will be readily apparent, therefore, from an examination of Fig. 2 that the study area possesses one of the most extensive tracts of really flat land within the city of Calgary.

Surficial Deposits

Although the entire study area is underlain by sandstones and shales of the Paskapoo formation, outcrops of these early Tertiary rocks are limited to a few occurrences along the valley bluffs.⁴ In the valley these rocks are overlain by stream alluvial deposits. This alluvium ranges in thickness from zero feet to fifty-eight feet and has an average depth of about twenty-two feet.⁵ It is only in east Calgary that glacial deposits are found: the dissected plateaux or buttes are mantled with a thin veneer of strat-

³ P. J. Smith, "Calgary: A Study in Urban Pattern", Economic Geography, Vol. 38, No. 4, October, 1962, p. 315.

⁴ Tharin, op. cit., p. 17.

⁵ Meyboom, op. cit., p. 36.

ified fluvio-glacial drift.

Consequently, the area under study corresponds well to the alluvial deposits as mapped by Tharin in 1960.⁶ This alluvium, deposited in conjunction with the development of the drainage system, was derived from glacial deposits of Cordilleran origin because the pebble content largely consists of quartzite and limestone elements from the Rocky Mountains. Generally, these deposits are well bedded and well sorted so that the gravel beds exhibit considerable lateral consistency. This property has been of importance in their utilization as groundwater aquifers and as raw materials in the construction industry. Generally, the clay content is small so that permeability is quite rapid thus facilitating good natural drainage. The percentage of fines increases, however, in the vicinity of the Bow channel due to vertical accretion and also in the old melt-water courses where lagoon development during the abandonment of these channels facilitated sedimentation of the fine content. In these portions of the valley, decreased permeability due to the concentration of silt and clay particles results in poor drainage, and marshes are a frequent characteristic of the spillway bottoms.

Water Supply

An abundant water supply is a fundamental characteristic of the study area and can be easily provided by, (1) gravity flow from the Glenmore reservoir on the Elbow River,

⁶ Tharin, op. cit., Map in back pocket.

(2) direct intake from the Bow River, and (3) groundwater from either the Paskapoo sandstone or the alluvial gravel deposits.

Presently the most important source is the Glenmore reservoir on the Elbow River. The Bow River has been used, however, and the city's original water supply system, established in 1891, depended on direct intake from the head race of the Eau Clair Lumber Company's dam near the present location of the Hillhurst Bridge.⁷ This system was subsequently improved and proved adequate when urban development was restricted to the study area. However, growth beyond the valley required costly pumping and favored the development of a gravity source on the Elbow River. The nature and quality of the Bow River supply also made desirable the establishment of an alternative source for the following reasons:⁸

- (1) During winter, floating or frazil ice causes blockages in the direct intake system.
- (2) A rapid rise in turbidity is associated with the spring break up of ice as well as with heavy summer rainstorms.
- (3) Erosion during flood stage can result in channel relocation leaving the former water intakes dry.

Despite these disadvantages, river water is used in industrial cooling and gravel sorting and is of adequate quality for these purposes.⁹

As was mentioned above groundwater supplies are obtainable from the sandstone and gravel deposits flooring

⁷ Pers. comm., R. O. Boswell, City Engineering Department, Calgary, 1964.

⁸ Ibid.

⁹ See Questionnaire Analysis in Chapter IV.

the valley. The quality of this water has been considered to be generally satisfactory for industrial and domestic purposes.¹⁰ Groundwater is currently used in Inglewood and Bonnybrook as an industrial coolant and in the downtown area for air conditioning. The total daily consumption has been estimated at some 8,000,000 gallons for these uses.¹¹ Local valley aquifers were also an important source of supply in residential areas prior to the establishment of a municipal water distribution system. Reserves are greatest near the Bow River, where continual seepage replenishes the aquifers, and in the bottoms of the meltwater channels. The low average annual precipitation of 16.87 inches makes the gravel deposits further from the channel less reliable sources. Nevertheless groundwater constitutes an important natural resource in this semi-arid region and Meyboom concluded that reserves were adequate for present and future industrial requirements.¹²

Flooding

Flooding as a problem for urban development has not commanded widespread attention in the past despite a long history in the study area. It will be obvious when the history of flooding on the Bow has been sketched that this factor has not been instrumental to a great degree in shaping the present land use structure except in the vicinity of the stream channel where extensive areas

¹⁰ Meyboom, op. cit., p. 1.

¹¹ Ibid, p. 59.

¹² Ibid, p. 60.

remain vacant.

Three types of flooding characterise the study area. In winter, due to the damming of slush ice in open water against barriers in the channel, high backwater stages can occur even with the normally low winter discharge.¹³ Second, spring flooding due to overbank discharge can result from one or more of the following factors: rapid snow melt in the watershed upstream; extremely heavy rainstorms or 'cloud-bursts'; and high groundwater levels already present in the vicinity of the city, especially after a rapid thaw. Third, high groundwater levels after the spring thaw or in exceptionally wet years may result in some basement inundation.

Winter flooding is not so catastrophic and does not attain the same dimensions as spring flooding despite its greater frequency.¹⁴ The highest backwater stage ever recorded was 12.9 feet above mean low water level registered at Bowness on December 31st, 1951.¹⁵ The record high for spring flooding was the seventeen feet reached in 1897 during the worst flood since the settlement was established

¹³ The term backwater refers to the rise of water at the head of an ice jam above the summer level of the river for the same flow.

¹⁴ Newspaper and Calgary Power Company records show that between 1903 and 1952 flooding occurred during the following winters: 1904-1905; 1906-07; 1907-08; 1908-09; 1910-11; 1911-12; 1916-17; 1926-27; 1927-28; 1932-33; 1935-36; 1937-38; 1938-39; 1940-41; 1941-42; 1942-43; 1943-44; 1944-45; 1945-46; 1946-47; 1947-48; 1948-49; 1949-50; 1950-51.

¹⁵ Submission of Calgary Power Ltd., op. cit., Part 2, Section 3, p. 7.

when a flow of 99,000 cubic feet per second was recorded.¹⁶ At this time sixty families were driven from their homes and total damage to property was estimated in the region of \$25,000.¹⁷ Damage would have been greater but for the fact that the northern valley flats were then vacant.

Table II on page 19 illustrates the magnitude and frequency of the major spring floods. From photographic records (see Plates 2, 3, 4 and 5) and from items in the local newspapers it is obvious that the areas inundated by spring flooding have been more extensive than those subjected to winter flooding. Fig. 3 compiled from all the available accounts of winter flooding shows that inundation due to ice jamming can generally be associated with some obstruction to river flow, either man built bridges or natural obstacles in the channel such as islands or bars. Ice tends to build up behind these to cause a localised rise in backwater stage in the vicinity. It might be noted in passing that the oft-afflicted Lowery Gardens were entirely evacuated through pressure brought to bear on the residents by the Water Resources Branch of the Provincial Department of Agriculture in 1940.¹⁸

¹⁶ annual Ibid, Part 2, Section 9, p. 9. This compares to an average flow of 3,247 c.f.s.

¹⁷ Ibid, Part 2, Section 4, p. 9.

¹⁸ Pers. comm., G. Underhill, Provincial Water Resources Branch, Calgary, 1963.

LOCATION OF WINTER FLOODING

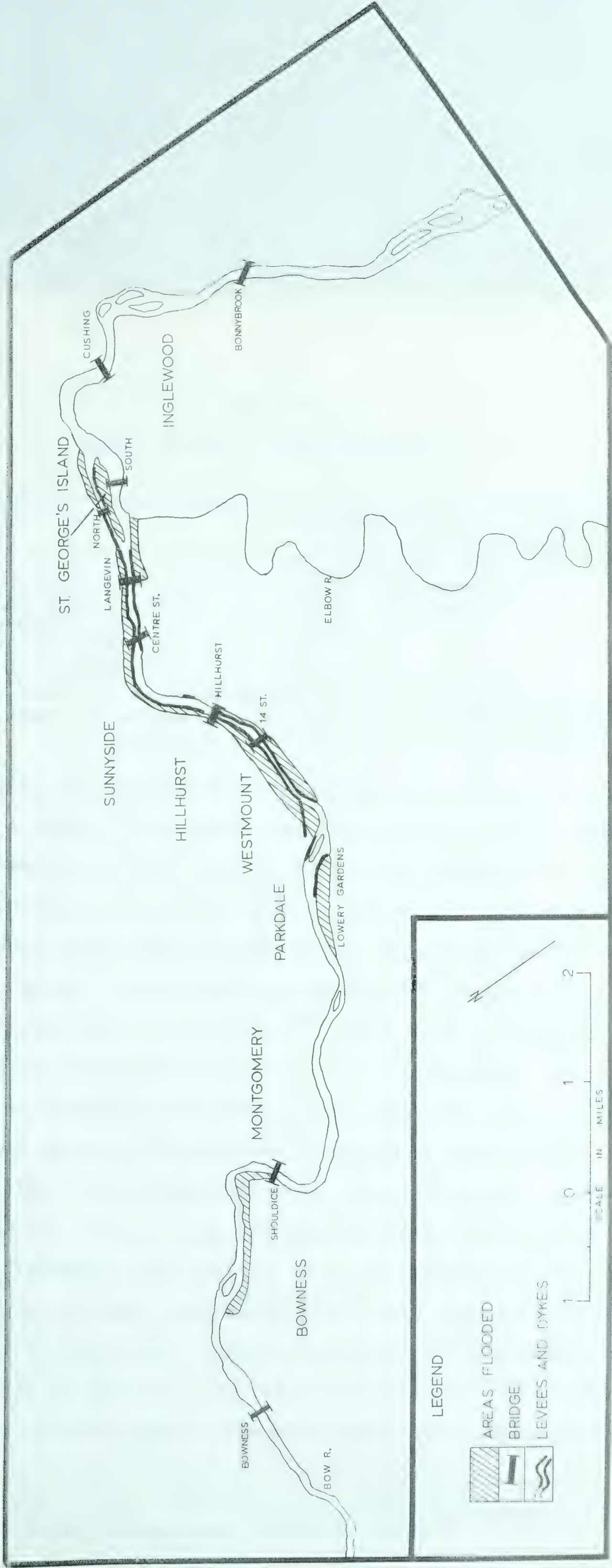


Fig. 3. Sources: The Calgary Herald, The Albertan, Calgary Power Ltd.

TABLE II

MAIN SPRING FLOODS ON THE BOW RIVER

DATE	DISCHARGE (cubic feet per second)
1884	(unknown)
June 1897	99,000 (estimated)
July, 1902	90,000 (estimated)
June 26, 1915	39,780
June 3, 1929	46,700
June 3, 1932	53,600
July 14, 1923	29,700

Source: Department of Northern Affairs and National Resources - Water Resources Branch, Calgary.

Table II illustrates the absence of serious flooding in recent years. Thus there has been no deterrent to urban encroachment onto land that is subject to inundation. The recent infrequency of major floods can in part be explained by the progressive development of the Bow River for hydro-electric power. These upstream dams affect 20 per cent of the watershed west of the city.¹⁹ When it is remembered that potential floodwaters in the form of snowmelt and rainstorms are more important in the mountains and foothills, the degree of protection provided is undoubtedly greater than that proportionate to one-fifth of the drainage basin for storage dams are restricted to these areas of high floodwater generation. Despite widespread controversy as to their importance ^{for flooding} these dams seem to have had two major consequences. First, as demand for and supply of electricity is just as great if not greater in winter than in summer, winter flow is now maintained at a higher level

¹⁹ Pers. comm., T. D. Stanley, Production Superintendent, Calgary Power Ltd., Calgary, 1963.

with a subsequent increase in flood hazard. Second, due to their combined storage capacity they have reduced the spring flow peak that is experienced in the city. It has been estimated that this storage capacity would take 20,000 c.f.s. off a repetition of the 1897 flood.²⁰ However, should a flood of such magnitude occur again heavy damage would still be experienced in a broad belt from the Canadian Pacific Railway northwards to the foot of the valley bluff. Although Calgary Power Limited maintains that storage on the tributaries is sufficient to abolish all risk of their flooding, the main stem of the Bow remains largely unprotected.²¹ In these circumstances the exact location of a rainstorm affects the probability of inundation downstream with the hazard increasing when 'cloudbursts' occur in areas possessing no storage capacity. This is important because an analysis of the causes of the Bow River spring floods shows that these localised downpours are of great significance. For example, the flood of June, 1915, was primarily due to heavy rainstorms in the watershed upstream during the period June 24th to 27th.²²

In 1952 a report by Calgary Power Ltd. suggested the construction of an additional dam and a complete levee system if all risk of inundation was to be abolished.²³ Except in east Calgary these levees were generally installed

20 Ibid.

21 Pers. comm., G. Underhill, Calgary, 1963.

22 Calgary Herald, microfilm for June, 1915.

23 Submission of Calgary Power Ltd., op. cit., Part IV, Section 1, p. 2.

wherever the river bank was less than fourteen feet above mean low water mark and are held to provide adequate protection against discharges of up to 50,000 c.f.s. Besides its effect as a regulating pond, the new Bearspaw dam traps ice formed above it and therefore reduces possible back-stage downstream. However, the fourteen mile stretch of channel between the Bearspaw dam and the study area permits further ice jamming to occur so that yet another dam has recently been advocated.²⁴

The City of Calgary has also been active in the field of flood investigation. A series of studies is currently being undertaken to determine precisely those areas subject to inundation with a view toward possible enactment of special zoning legislation.²⁵ In the past, however, little consideration was afforded to flooding as a possible development hazard and William Pearce stated in 1924 that 25 to 40 per cent of the valley should never have been developed.²⁶ He predicted that someday a heavy price would have to be paid for this 'mistake'. That day has still to dawn but although forty years have passed there is no adequate guarantee that such an event is impossible.

Slope Instability

Slope instability is a minor problem which can affect land use along the steeper valley bluffs. The problem is

²⁴ Pers. comm., T. D. Stanley, Calgary, 1963.

²⁵ Pers. comm., H. McCollister, Calgary, 1963.

²⁶ Bow River Story. A series of articles published by The Albertan, Calgary, 1960.

particularly severe in the Crescent Heights area where the most recent slide occurred in 1960. In this area alone, since 1948, some \$500,000 have been spent on remedial measures.²⁷

Slides in the study area seem to result from three factors all of which lower the shearing resistance of the slope: rapid increase in piezometric head due to increased percolation in spring and early summer; deterioration of slope material due to frost action; and the presence of lenses of sand and gravel retaining water which acts as a lubricant.²⁸ The end result of these factors is a downward movement of material leaving crevasses and scars at the side and top of the slide area. The presence of water may cause the slide to turn into a slurry or mudflow at its toe. Such a transfer took place in 1960 and The Calgary Herald for July 25th reported that 'since April a ten feet high mound has covered one section of the (dwelling's) backyard and surrounds the garage' (see Plate 6). Some houses in the vicinity of Crescent Heights had been moved after previous slides.

Attempts to stabilise the slope through colonisation by vegetation have met with little success, largely due to the frequency of movement. More successful but rather unsightly has been the dumping of sand and gravel in an attempt to increase permeability.²⁹ Such mass wastage can

²⁷ Meyboom, op. cit., p. 61.

²⁸ Ibid. p. 66.

²⁹ pers. comm., H. Boothman, Superintendent, City Parks Department, Calgary, 1963.

readily be seen to affect both the top, through subsidence, and the bottom, through accumulation, of the slide area.

Virtually every place along the Bow River where the steep valley walls are composed of relatively impermeable material is a potential slide area and the danger is accentuated where the river is actively engaged in undercutting.

Air Pollution

Some atmospheric pollution is characteristic of the study area and results from temperature inversions and windy conditions. The former are frequent in river valleys and result from the downward drainage of denser cold air from the valley sides. They favor air pollution for dust, smoke and fumes are unable to escape upwards. Winds of high velocity result in deflation of the surface deposits and this is especially common in areas where construction has laid bare the surface. Thus there exists a tendency for westerly winds to channel dust through the study area particularly during periods of dry weather.

Generally, however, atmospheric pollution is not a serious problem in the study area as the prevailing wind is from the west and industry is strongly concentrated in the east and southeast. Another favorable factor is the high percentage of 'clean' industry that characterises the industrial structure of Calgary.

The first part of the paper discusses the importance of the study and the objectives of the research. It also mentions the scope of the study and the limitations of the study.

The second part of the paper discusses the methodology used in the study. It mentions the data sources and the data collection methods used in the study.

The third part of the paper discusses the results of the study. It mentions the findings of the study and the conclusions drawn from the study.

The fourth part of the paper discusses the implications of the study. It mentions the practical implications of the study and the theoretical implications of the study.

The fifth part of the paper discusses the limitations of the study. It mentions the limitations of the study and the limitations of the study.

The sixth part of the paper discusses the conclusions of the study. It mentions the conclusions of the study and the conclusions of the study.

The seventh part of the paper discusses the future research. It mentions the future research and the future research.

The eighth part of the paper discusses the references. It mentions the references of the study and the references of the study.

The ninth part of the paper discusses the appendices. It mentions the appendices of the study and the appendices of the study.

The tenth part of the paper discusses the index. It mentions the index of the study and the index of the study.



Plate 1. Residential development on the valley bluff, north Bridgeland.



BY COURTESY OF CALGARY POWER LTD.
Plate 2. Looking north towards Langevin Bridge during the flood of 1902.



BY COURTESY OF CALGARY POWER LTD.
 Plate 3. Looking north from Bow Marsh Bridge towards Hillhurst from the south bank of the Bow during the flood of 1902.



BY COURTESY OF CALGARY POWER LTD.
 Plate 4. View north at the southern approach of Bow Marsh Bridge from the south bank of the Bow during the flood of 1902.



BY COURTESY OF CALGARY POWER LTD.
Plate 5. Looking northeast at houses on east side of Fourth Street East during the flood of 1902.



Plate 6. Slide area near Crescent Heights showing the bare slope. Note encroachment of deposits near the house in the middle distance.

CHAPTER III

LAND USE

A. THE EVOLUTION OF LAND USE AND TRANSPORTATION PATTERNS IN THE STUDY AREA

Introduction

The aim of this section is to trace the history of development in the study area bearing in mind the physical nature of the valley as discussed in the preceding Chapter. It is important to stress at the outset that, until the 1920s, the history of Calgary was essentially that of the study area because the city was then largely contained within the river valley. Subsequently, development extended beyond the valley confines to the higher benchlands. A minor theme in the discussion below will be the relationship between growth in the valley and that elsewhere within Calgary.

Historical Development

Initial interest in the Calgary area may be attributed to the physical environment of the study area. The sheltered, well-watered valley of the Bow River favored wildlife and was used as a wintering ground by the plains buffalo. The area, therefore, attracted the local Indians and, in the 1860s, there grew up an illicit trade in whisky conducted from Montana. It was in an endeavor to control the whisky trade that

the North West Mounted Police erected a fort in 1875.¹

The police fort, constructed by the I. G. Baker Company, represented the first permanent white settlement in the area and was located on a portion of elevated ground west of the confluence of the Bow and Elbow rivers.

Shortly after the erection of the fort, the Hudson's Bay Company built a trading post and by 1881 the settlement had a population of seventy-five persons.² At this time Calgary consisted of the Hudson's Bay Company's store, an I. G. Baker store, the residence of the commanding police officer and the company barracks as well as some cabins used by men engaged in transportation between Fort Benton in Montana and Edmonton. All of these structures were situated to the east of the river confluence in Section 14, Township 29, Range 1, west of the Fifth Meridian. The land to the west of the Elbow River was used by the police for stabling and grazing purposes around the fort. In the years immediately following, the work of the police proved so successful that the detachment was reduced to ten men and trading became the mainstay of the new settlement.³

Undoubtedly the major factor in the settlement and the subsequent great agricultural expansion of the early

¹ Bussard, op. cit., p. 23.

² Municipal Manual, City of Calgary, Calgary, 1964, p. 23.

³ P. J. Smith, General Plan of Calgary, Unpublished manuscript, City Planning Department, Calgary, 1958, p. 5.

twentieth century was the decision to use the valley of the Bow River for the transcontinental Canadian Pacific Railway. This decision was prompted by the presence to the west and northwest of Calgary of hilly regions through which it would have been extremely difficult to run a railroad.⁴ The new settlement was also selected as the Canadian Pacific Railway's major maintenance centre for the western section of the prairie region. The transcontinental railway eventually reached Calgary along the valley flat from the east on August 28, 1883 and almost overnight the settlement became the distribution centre for a vast area of southern Alberta. In later years the relationship between valley and railway location was greatly consolidated with the construction of industrial sidings and of branch lines to service the rich agricultural hinterland. These facilities were all provided on the valley flats. The absolute dominance of the study area in the development of the transportation network was further strengthened with the introduction of the Canadian National Railway system in 1913.⁵

The presence of the Canadian Pacific Railway has had two major consequences for development in the study area. The Company was, firstly, responsible for an actual change in the location of the townsite. Having acquired rights to every odd numbered section along its right-of-way, the Company's station, the post office and freight warehouses

⁴ Pers. comm., J. Merkel, Public Relations Officer, Canadian Pacific Railway, Calgary, 1963.

⁵ Municipal Manual, op. cit., p. 30.

were all established west of the Elbow River in Section 15. These structures acted as a magnet to other commercial development and it was around this nucleus that there developed the central business district of today.⁶ Secondly, the railway company was responsible for industrial and residential development being strung out tenuously to the southeast along the axis of the Bow River. This pattern of growth was first initiated as the result of the Ogden Agreement of 1911 between the Canadian Pacific Company and the city of Calgary.⁷ Under this the major repair work for Alberta, British Columbia and Saskatchewan was to be carried out at Ogden in southeast Calgary on Company owned land and the railway shops were commenced in that year. The Canadian Pacific Railway Company also agreed to lay out land for housing at Ogden and Ceepeear while the city agreed to provide street car facilities between these new subdivisions and the urban centre located some five miles to the northwest. A strong relationship between industrial location and railway facilities resulted in the early concentration of industrial premises on the valley flats of the study area.

As ranchers and homesteaders moved into the western prairies, the town, as it was from 1884, grew rapidly and some reflection of the prevailing optimism may be gauged from the establishment as early as 1885 of the Cal-

⁶ Smith, op. cit., p. 19.

⁷ Pers. comm., J. Merkel, Calgary, 1963.

gary Board of Trade.⁸ At this time the town had a population of about one thousand and was entirely situated on the valley flat between the railway tracks and the Bow River.⁹

The impetus given by the railway to agricultural expansion is reflected in the nature of the early industrial establishments. These were basically concerned with the storage and processing of grain and livestock and were located on the valley flat in close proximity to rail and warehousing facilities. Even today, these industries together with the petroleum industry constitute the most distinctive elements in the industrial structure of the city. The first meat packing plant was established in 1890, the first flour mill in 1897, the first brewery in 1892, while the Calgary stockyards opened in 1903.¹⁰ Side by side with this industrial growth there occurred a proliferation in the number of construction and business firms required to service the growing town and its expanding agricultural hinterland.

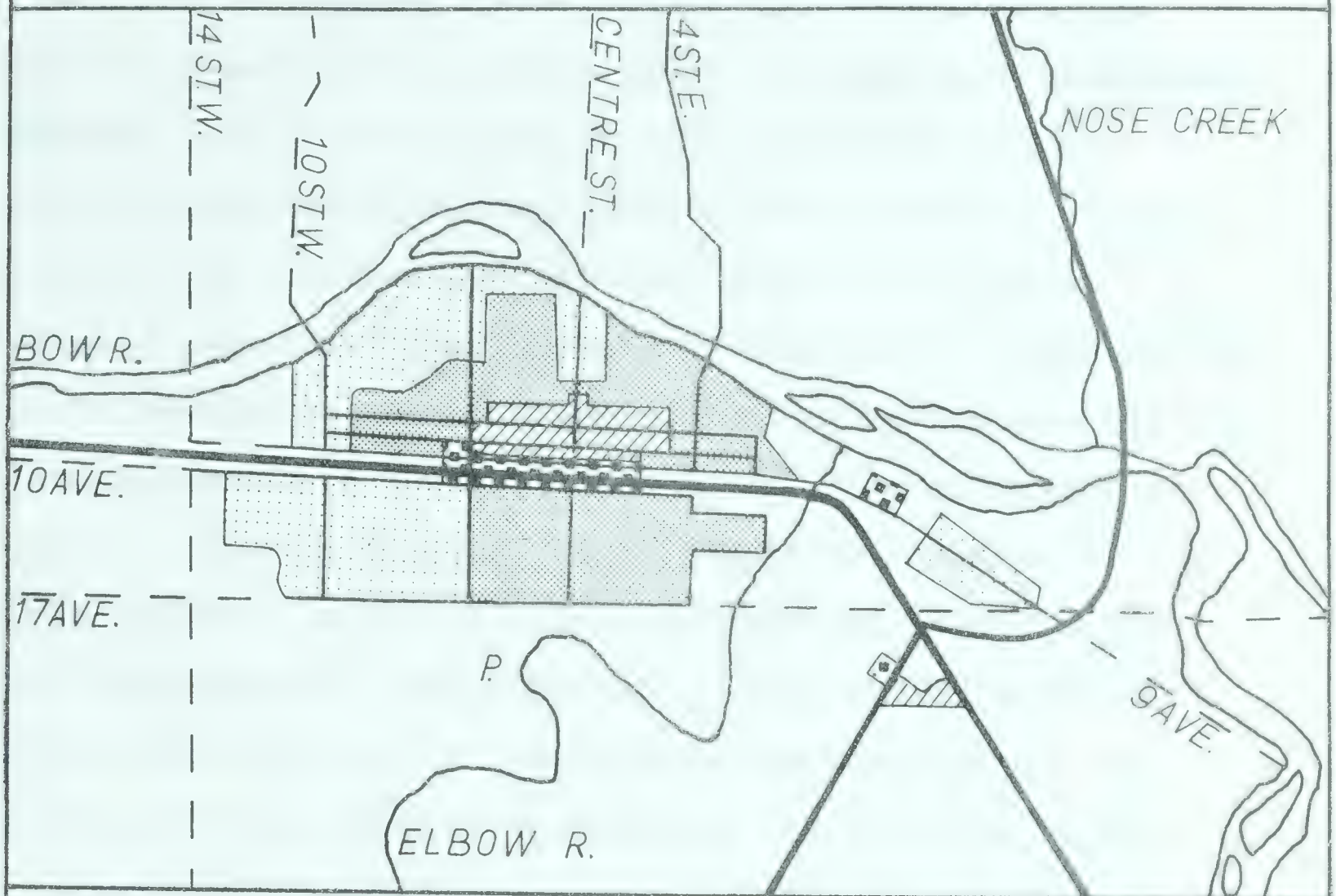
The limited amount of historical mapping from street directories that was undertaken makes it possible to provide a reasonably accurate picture of the land use structure of the city for 1904. It will be readily apparent from Fig. 4, that, at this date, the built up area was entirely restricted to the valley flat. The commercial district consisted

⁸ Municipal Manual, op. cit., p. 27.

⁹ Loc. cit.

¹⁰ Smith, op. cit., p. 9.

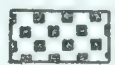
LAND USE 1904



LEGEND



BUSINESS



INDUSTRY



RESIDENCES



SCATTERED RESIDENCES



MAJOR PUBLIC USE



RAILWAY



MAJOR EXISTING STREETS 1904



MAJOR STREETS 1964

1 0 1 2 3
SCALE IN 1000 FEET



Fig. 4. Source: Henderson's Street Directory 1904

essentially of a strip along Eighth Avenue from Third Street East to Fourth Street West. This Avenue was the major west-east axis of development although some commercial premises were located along Seventh and Ninth Avenues. A minor concentration existed along Centre Street in the vicinity of the intersection with the major axis, Eighth Avenue. Industrial development was essentially concentrated to the west of the Elbow River along the avenues immediately north and south of the railway tracks. Some scattered industrial pockets, however, were located to the east of the river junction in the district now known as Pearce Estate. Both the commercial and industrial areas showed a marked orientation parallel to the railway and their origin and development were largely governed by the location of the Canadian Pacific Railway's tracks and facilities such as the station and freight office. Surrounding both these zones residential areas spread out over the valley. Although less densely settled to the south of the railway, the residential area extended almost to the foot of the delimiting valley bluff. Development to the north of the track encircled the downtown area and at several points reached the south bank of the Bow River. Density of development, however, decreased with distance from the commercial area. Some residential growth remained on the site of the original settlement to the east of the river confluence. The northern valley flat had no urban development and in 1904 was used as farmland.

When Fig. 4 is compared with Fig. 5, it is obvious that the basic elements of the present land use pattern were firmly established by 1904. Development in the intervening period has generally confirmed and extended the early land use pattern. Commercial and industrial zones show the same preferred west-east orientation associated with the railway. The residential area, although greatly expanded and presently covering the surrounding benchlands, still exists essentially as a concentric zone around the downtown core.

As a result of the phenomenal agricultural expansion of the early twentieth century, a land boom occurred in Calgary during the period 1908-12.¹¹ Although much of the subsequent subdivision was speculative in character, population increase was rapid. The decade between 1901 and 1911 witnessed a tenfold population increase from 4,091 inhabitants to 43,704 (see Table III below).

TABLE III
POPULATION GROWTH WITHIN CALGARY 1884 - 1964

YEAR	POPULATION
1884	506
1901	4,091
1911	43,704
1921	63,305
1931	83,761
1941	88,904
1951	129,060
1961	241,675
1964	294,924

Source: Dominion Bureau of Statistics and Civic Census Reports.

¹¹ A. G. Dalzell, Urban Development in Canada and its effect on British Immigration, unpublished presidential address to the Town Planning Institute of Canada, 1930, 11 pp.

The proposed development was based on a grid iron street layout which was superimposed on the valley regardless of physiography and the railway pattern. Only in Mount Royal was any consideration afforded the natural contours of the land and this area remains a high class residential neighbourhood. The proposed method of subdivision was subsequently adopted and has given rise to access difficulties for many firms in the valley. Underpasses and rail crossings have become necessary and have reduced the efficiency of the circulation system. The extent of the boom is reflected by the fact that the number of building permits issued in 1912 was not surpassed until the 1950s when the second great land boom was well under way.¹² The land boom tended to produce piecemeal growth in later years for, as the entire valley area was under subdivision, development could not be guided to a particular district.

The boom period eventually collapsed in 1912 and the succeeding thirty to thirty-five years were characterised by slower growth. Although the population doubled between 1911 and 1941, these years were characterised by periods of relative, if not actual decline. Between 1931 and 1936, the population decreased from 83,761 to 83,407.¹³ These years were also marked by an increase in municipal taxation rates to pay for the enormous water and sewerage networks

¹² Municipal Manual, op. cit., p.81.

¹³ Loc. cit.

constructed to service the proposed subdivisions of the boom period. This factor contributed to the growth beyond the city of the satellite suburban communities of Bowness and Montgomery. These northwestern valley settlements were linked to the city along the valley by street car under the Shouldice Agreement.¹⁴ The decline in construction within the city during this period may be grasped from the fact that only 772 building permits were issued in 1915. This figure represents a significant decrease over the 3,843 permits issued in 1912 when it is remembered that the population had risen some 20,000 in the interim.¹⁵

Nevertheless it was during this period of mixed fortunes that the petroleum and allied industries arose in the valley where suitable flat land and rail facilities were easily available. The discovery of oil in the Turner Valley area led to the construction of the city's first oil refinery in east Calgary in 1922.¹⁶ It was not until the Leduc and subsequent discoveries of the 1940s, however, that the petroleum industrial complex assumed major significance. Since then another oil refinery, major petrochemical plants and a whole array of service industries have located in the valley. The former have been largely located out of considerations of flat land, ease of transport and water supply, while the latter find it advantageous to be sited in close proximity

¹⁴ Pers. comm., J. Eastwell, Research Planner, City Planning Department, Calgary, 1963.

¹⁵ Municipal Manual, op. cit. p. 81.

¹⁶ Ibid., p. 31. Turner Valley is located some thirty miles to the southwest.

to their customers. The effects of the oil boom are best seen in the great influx of population. Between 1951 and 1961 the population of the city almost doubled from 129,060 to 241,675 inhabitants (see Table III). Calgary has also emerged as the administrative centre of Canada's petroleum industry and this has been reflected by an upsurge in office construction in and around the central business district. The associated service, maintenance and supply industries have helped diversify the industrial structure of the city and have provided a broader and sounder economic base. To-day there are about 400 such firms with their headquarters in the city and these are heavily concentrated in the study area.¹⁷ The supreme importance of the petroleum oriented industry to the city may be judged from the following figures.¹⁸ Based on the 1960 city population of 235,000, it was estimated that this complex accounts for one-eighth of the population, one-fifth of the employment, one-sixth of the homes, one-third of the telephones, one-quarter of the school enrolment and one-sixth of all automobile registration.

The phenomenal urban growth of the 1940s and 1950s has been accompanied by an increase in the value of building permits ^{fourteen} from ~~four~~ million dollars to around one hundred million dollars between 1948 and 1958.¹⁹ The expand-

¹⁷ Pers. comm., K. Ford, Industrial Development Co-ordinator, City Industrial Development Department, Calgary, 1963.

¹⁸ 'The Calgary Herald', Calgary, September, 1961.

¹⁹ P. J. Smith, Land Use Patterns in the City of Calgary, unpublished paper read to the Canadian Association of Geographers, Edmonton, 1958, p. 6.

ing construction industry is largely located in the study area where the gravel deposits constitute an excellent source of raw materials for the manufacture of building materials. These bulky raw materials are costly to transport so that the processing plants are generally close to gravel pits. Timber processing firms also locate in the study area close to railway facilities.

The above discussion has shown how the transportation pattern in conjunction with valley form has frequently shaped the nature of development in the study area. It is to a description and analysis of the present land use that attention will now be focussed.

B A DESCRIPTION AND ANALYSIS OF THE PRESENT LAND USE PATTERN

Introduction

Although an examination of land use in the study area is the principal objective of this section, some account will be taken of the entire urban area. Wherever pertinent, the physical characteristics of the valley will be emphasized as determinants of land use.

Information on the distribution of land uses on a city-wide basis was derived from the Planning Department of the City of Calgary which has mapped the entire urban area on a scale of 1 inch to 400 feet. A municipal report, dated 1956, deserves special mention as it presents a detailed statistical breakdown of land use data.²⁰ This

²⁰ Report on Land Uses within the City of Calgary, City Planning Department, Calgary, 1956, 50 pp.

LAND USE 1964

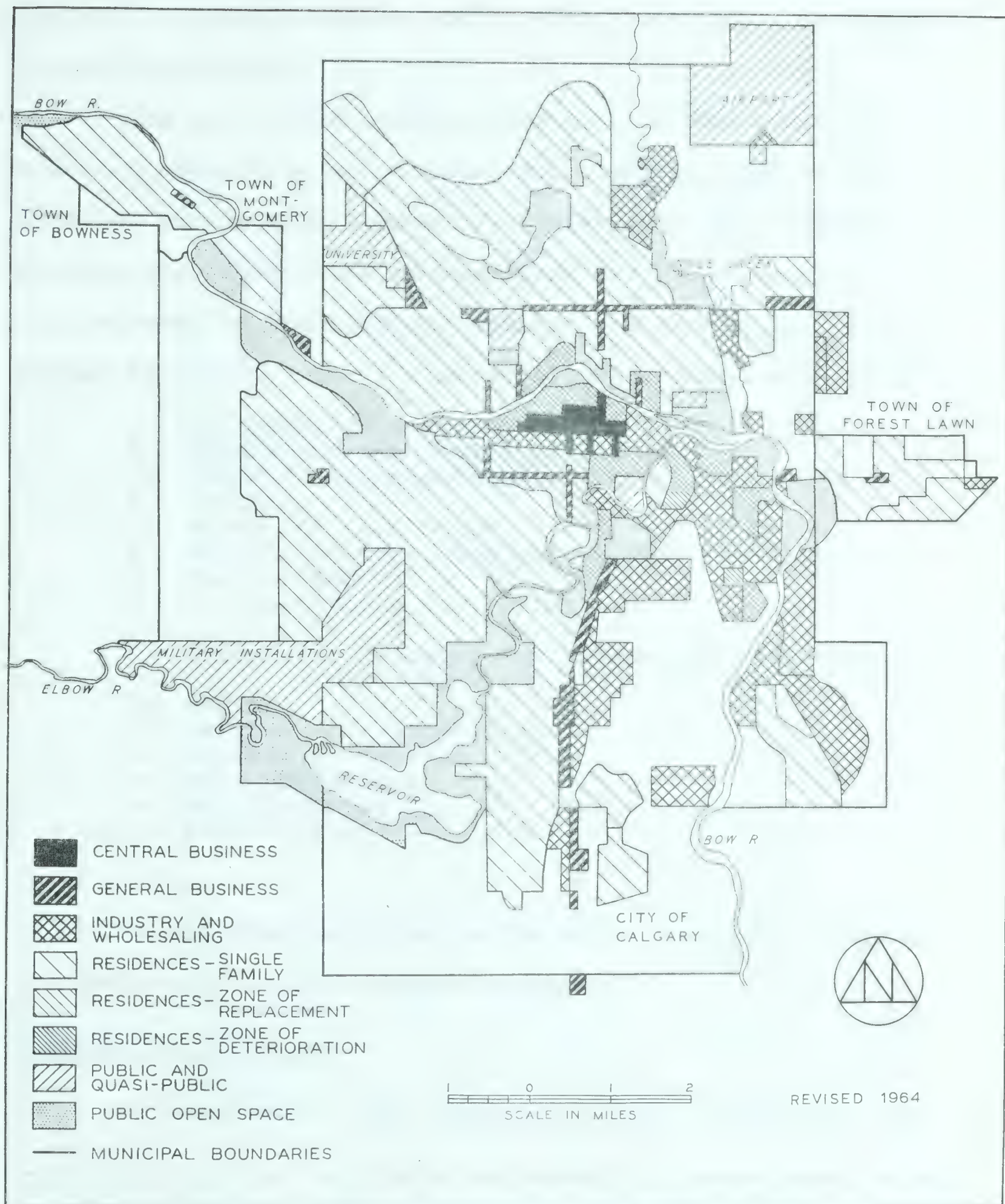


Fig. 5. Source: Smith, Calgary: A Study in Urban Pattern. See Bibliography.

report is modelled on Bartholomew's research on urban land use and although somewhat out of date, provided a valuable source of material.²¹

The land use classification used by the municipal planning department was adopted for the field survey in order to obtain some degree of standardisation. However, as industry constitutes an important use in the valley, this element of the land use pattern was broken down and mapped in detail. The following classification was adopted:

1. Business and commerce
2. Single and two family residences
3. Multi-family residences
4. Industry
5. Parks and open space
6. Public, cultural and educational facilities
7. Vacant land
8. Transportation facilities.

The industrial category was subdivided as follows:

- (a) Mining
- (b) Agricultural processing
- (c) Mineral processing
- (d) Wood processing
- (e) Manufacturing 22
- (f) Wholesaling

In the discussion below the major land use categories are dealt with under separate headings.

Business and Commerce

As was seen in the previous section the central bus-

²¹ H. Bartholomew, Land Use in American Cities, Cambridge, Mass., 1955, 196 pp.

²² As its site requirements are frequently similar to those of industrial premises, wholesaling has been considered an industrial use.

iness district is located in the valley and has grown up in the vicinity of the Canadian Pacific Railway station. The juxtaposition of the railway and the business district emphasizes the necessity in former days of adequate transportation facilities to serve all enterprises alike. Today this need has been largely replaced by a complex interdependence of business and commercial organization and the labour market attraction of a central confederation of interests. In recent years, it has been these economic advantages that have accounted for the continued presence of the business district in this area. Today the district displays a distinct elongation in an east - west direction along Seventh and Eighth Avenues between Third Street East and Ninth Street West. Western extension to avoid the older, more dilapidated eastern zone has been a recent feature in the development of the central business district (see Plate 7). This expansion has occurred through the provision of many administrative office buildings and retail show rooms. The tendency towards a pronounced linear business district has to some extent been combatted through growth to the north. Automobile show rooms, used car lots and office construction have been the principal elements behind development to the north of the former downtown core (see Plate 8). Although some central district retail uses have infiltrated to the south of the tracks, the railway can be taken as the effective southern boundary of the district. However, as Fig. 5 illustrates, linear extensions of the business district can



Plate 7. Looking towards the central business district from the west. Note the recent office construction.



Plate 8. New office towers in the north of the central business district.

be related to the major thoroughfares entering the downtown area, for example Centre Street and Fourth and First Streets West.

In 1956, approximately one-third of the total commercial area of the city was located in the central business district.²³ The remainder, although exhibiting a scattered distribution, was essentially concentrated along the major arterial routes. This has given rise to the development of a series of linear commercial strips with localized concentrations where two such streets intersect. These strips although especially characteristic of thoroughfares in the newer areas, are also found in the study area long Seventeenth Avenue Southwest and Ninth Avenue east of the Elbow River (see Plate 9). Dispersed commercial development of the corner store variety is found among the older areas of the valley and is less frequent in the more recently developed subdivisions. The trend here is towards the regionalisation of retail uses in planned shopping centres.

The presence of the railway and its tentacular effect on early development provides the only link between the physical nature of the study area and its commercial pattern. This indirect relationship, as will be shown below, is one that is not restricted to commercial land use.

²³ Report on Land Uses within the City of Calgary,
op. cit., p. 4.

Residential Use.

Almost all of the residential development arising from the post 1945 boom was accommodated by single family residences in new subdivisions out of the river valley. Only in the extreme northwest and southeast of the study area, where there was still some vacant land, did any substantial growth take place. This new construction in areas such as Bowness and Lynwood contrasts markedly with the remainder of the residential development in the valley for much of this is thirty-five to forty years old (see Plates 10 and 11).

From an examination of Fig. 5 it is possible to divide the study area into four zones on the bases of residential characteristics. These are, (1) the area entirely enveloping the central business district west of the Elbow River where much of the housing is of pre-1912 vintage, (2) the area east of the Elbow where residential enclaves are scattered among industrial and commercial zones, (3) the northern valley east of Tenth Street West characterised by relatively old but generally well maintained houses, and (4) the area west of Tenth Street on the northern valley flat where the most recent development has occurred.

(1) Central Business District Envelope

This area extends around the downtown area, northwards to the Bow River and southwards to the bounding valley bluff. It is the area having the oldest dwelling units, many of which on the periphery of the central business district



Plate 9. Strip commercial development along Seventeenth Avenue South West.



Plate 10. The recent residential subdivison of Lynwood incorporates crescentic street design.



Plate 11. Older residential development in east Calgary.



Plate 12. Invasion of incompatible uses among the older residences north of the central business district.

have undergone conversion to multi-family use. The result is the presence of a zone of relatively high population density so that the average gross density is 18.5 persons per acre as compared with the city average of 10.2 persons.²⁴ The area is also susceptible to invasion and succession by such incompatible land uses as commerce and industry (see Plate 12). Urban blight and physical obsolescence prevail among many of the dwelling units, particularly those closest to the downtown area. This is the area frequented by recent immigrants, minority ethnic groups and families in the lower income brackets. However, residential deterioration is not so marked south of the railway tracks where recent apartment construction has done much to restore the livability of the area.²⁵

(2) East Calgary

Here residences are found in pockets among incompatible uses such as industry and railway facilities. These pockets were stimulated by the need for low cost residential areas to be located in close proximity to industrial development. Also such special factors as the Ogden Agreement of 1911 favored the establishment of these enclaves. Subsequent industrial expansion has resulted in the isolation of these areas.²⁶ Many of the characteristics discussed above

²⁴ Smith, Draft General Plan, op. cit., p. 22.

²⁵ Idem, Calgary: A Study in Urban Pattern, op. cit., p. 320.

²⁶ Idem, A Preliminary Report on Urban Renewal in the City of Calgary, City Planning Department, Calgary, 1959, pp. 14-16.

in conjunction with (1) are repeated in east and southeast Calgary. In addition, the indiscriminate adoption of the grid iron pattern of subdivision contributes to the deterioration of the residential environment as there is little segregation of traffic. However, where they are remote from through traffic, these zones have maintained some of their original charm, for example in the north of Pearce Estate (see Plate 13). Any new residential development that has taken place has been in-filling so that many of these pockets are characterised by a mixture of dwelling styles.²⁷

(3) The Northern Valley Flat East of Tenth Street

Dwelling units here are not as old having been largely constructed in the period between the two great booms. Due to the distance of this district from the downtown area, deterioration of the residential environment through functional obsolescence has not been so widespread. However, some incompatible industrial and commercial uses have invaded the area. These are usually restricted to the major thoroughfares such as Tenth Street West and Centre Street. Dwelling units are, therefore, generally better than in zones (1) and (2). Today the area is easily accessible to the downtown core so that considerable apartment construction has taken place in recent years. Landscaping near the river channel in conjunction with east - west

²⁷ Ibid., pp. 14 - 16.



Plate 13. In Pearce Estate traffic segregation preserves the livability of this older residential area.



Plate 14. Well maintained houses in the Sunnyside district.

thoroughfare construction imparts a pleasing appearance to neighbourhoods such as Hillhurst and Sunnyside (see Plate 14).

(4) Area West of Tenth Street North

This area contains most of the post 1945 housing of the river valley either in new subdivisions, such as Parkdale, or around existing nodes as in Montgomery and Bowness. This area is characterised by single family, low density development (see Plate 15).

Physical Characteristics and Residential Development

The major importance of physical factors in residential expansion lies in the control they exercise over the provision of water and sewerage networks. These utility patterns are closely tied to considerations of slope and surficial deposits. Servicing is greatly enhanced where natural gravity flow exists while costs are multiplied on irregular topography or where impermeable deposits are encountered. The distribution of water is limited primarily by pressure directly proportional to the distance from, and height above the source of supply. Modern sewerage systems must take into consideration the natural subsurface drainage before disposal or treatment plants can be located.

The flat, lowlying river valley, therefore, favored the early establishment of these utility networks. Gravity flow from sources on the Elbow River made water distribution easy on the valley flat while the underlying sandy deposits were excellent for sewage disposal as also was the swift



Plate 15. Recent single family residential dwellings in Parkdale.



Plate 16. Light industry in the wholesaling district south of the central business district.

flowing Bow River. Direct disposal of wastes to the river was customary until the installation of the Bonnybrook treatment plant in 1932.²⁸

It is no surprise, therefore, that the study area was largely developed before the city spread over the more irregular terrain above the valley. The provision of water supplies in the latter area has been a major obstacle to orderly development and necessitates costly pumping. Sewage disposal is also complicated by variations in subsurface flow due to the presence of many drainage basins.

Industry

Fig. 6 illustrating the distribution of industry within the city emphasizes the concentration of this type of land use in the study area. Within the valley itself, there are two major zones of concentration. The first is located west of the Elbow River in a belt surrounding the central business district. The second zone embraces all of the valley east and southeast of the Elbow confluence. Although the density of industrial premises is not as great here as in the central zone, this area possesses the heavier and more important petroleum and agricultural processing establishments.

The central industrial area forms an arc to the north of the business district and exists to the south as an elongated belt parallel to the railway tracks. This is the area that is also characterised by the greatest density of multi-family residences indicating that proximity to the

²⁸ Pers. comm., C. D. Howarth, City Engineer, City Engineering Department, Calgary, 1963.

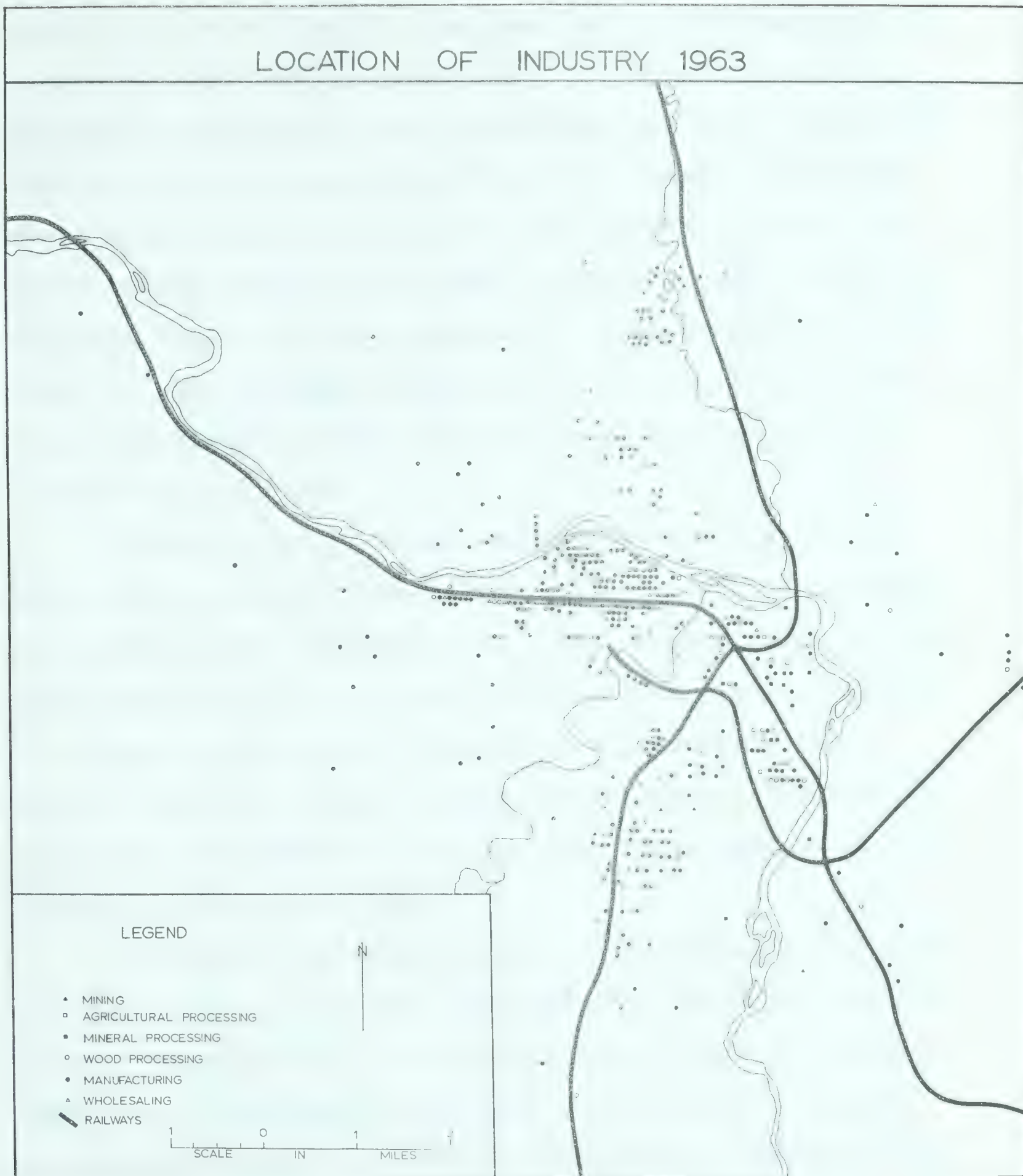


Fig. 6. Source: Manufacturer's Directory, Calgary,
Department of Industrial Development 1963 and Field Work 1963

central business district has resulted in the emergence of a zone of high density population. Light manufacturing, wholesaling and warehousing constitute the basic industrial character of this area (see Plate 16). Recent growth has taken place westward along Tenth and Eleventh Avenues towards Lowery Gardens with modern warehouses and lumber industries being the major elements in this extension. Proximity to rail transportation and the availability of flat land have played a great role in the recent location of industry in this area.

The district of major warehousing and wholesaling activities is located immediately to the south of the railway tracks in the downtown area. The Canadian Pacific Railway Company itself has leased parts of its right-of-way in this zone to wholesalers requiring rail accessibility. Despite the pull towards highway locations arising from the increasing popularity of road haulage, this area remains an important wholesaling zone.

Industrial premises in the central manufacturing belt are generally old and have suffered from physical deterioration. More important is the fact that they have become to some extent functionally obsolete and unsuited to modern methods of handling and storing merchandise. However, because of its centrality to the entire urban area this district remains important to firms marketing goods and services over the whole city. Manufacture of clothing, jewellery and printing supplies are other industries favor-

ing a downtown location. These frequently occupy space above the ground floor and benefit from the proximity of professional and office concentrations as well as the pedestrian movement generated by the central business district.

The downtown industrial district, although characterised by a wide variety of activities, is of secondary importance and has few of the more important industries in the city. This heavier industry, comprising agricultural and petroleum processing establishments and their associated ancillary trades, is essentially located to the east and southeast of the Elbow River (see Plates 17 and 18). This pattern arose early in the history of the city for the valley flats facilitated the easy provision of spur line trackage and necessary utility systems. The mining of sand and gravel for the construction industry is also largely concentrated in this zone. These industrial groups, so typical of Calgary, all prefer location in the study area out of consideration for one or more of the following factors: abundant, easily serviceable flat land; good rail transportation; ease of water supply; and suitable construction raw materials. (see pages 51 - 55).

It is the official policy of the city of Calgary to continue this industrial concentration in the southeast. This it has achieved to date through the establishment of areas for development as municipal or private industrial estates. This policy of planned industrial growth has met with much success in recent years and the first two city developed estates have been entirely allocated to indust-



Plate 17. View of part of the Calgary stockyards. Note rail facilities in the middle distance.



Plate 18. Imperial Oil Company refinery in east Calgary.

rialists.²⁹

A minor belt of industrialisation extends northwards along Nose Creek parallel to the Edmonton branchline of the Canadian Pacific Railway network. Apart from this industrial arm there is a marked absence of any major development on the valley flat north of the Bow River. Here the more restricted nature of the valley did not prove so attractive to industrialists or railway builders. Consequently, the only establishments present to the north ^{essentially} consist of service firms such as neighbourhood bakeries.

In recent years while heavy industry has continued to locate along the valley plain, light industry has favored establishment on the higher plateau land to the west between the Bow River and Highway 2 South (see Plate 19). These latter areas have easy access to both road and rail facilities and were the sites chosen by the city for industrial estates in the 1950s.

In 1956 some 4.8 per cent of the total developed area of the city was devoted to industrial use.³⁰ The obvious concentration of industry of all types in the study area is borne out by the fact that here it accounts for approximately 28 per cent of the total area of the river valley.

Physical Characteristics and Industrial Location

Discussion of the relationship between industry and

²⁹ Municipal Manual, op. cit., p. 10.

³⁰ Report on Land uses in the City of Calgary, op. cit., p. 5.

valley form is held over until the succeeding chapter and will be examined in conjunction with an analysis of the industrial questionnaire.

Recreation and Open Space

The valley bluffs provide a valuable source of open space for they are generally too steep to be developed. Although much of this area was formerly wooded, the slopes are bare today and it is only in the west that the southern bluff is forested to any extent. The only extensive areas that could not be considered as open space occur in north Bridgeland, Mount Royal and Sunalta, where low density residential development has occurred on the gentler slopes.

Recreational use of floodplain land has occurred on the islands in the Bow River channel as well as along the river bank east of the Elbow junction. Set aside for recreational purposes as early as 1890, Prince's Island and St. George's Island have been preserved in their natural state.³¹ The latter has been intensively developed and is the site of the Calgary Zoological Gardens. Bordering the river channel in the Inglewood district, areas have been laid aside for a bird sanctuary, golf course and natural parkland suitable for such passive forms of recreation as walking and picnicking. The east - west arterial road located parallel to the northern river bank has been extensively landscaped and contributes to the aesthetic appeal of the area.

³¹ Municipal Manual, op. cit., p. 28.

Elsewhere in the study area, recreational areas such as neighbourhood parks and skating rinks have been established as part of total community development. However, these facilities, as well as commercial forms of recreation such as bowling alleys, are in no way related to the physical character of the study area.

Although physical factors such as flooding may have had a role in the fashioning of the recreational land use pattern along the Bow River, it should be recognised that other factors have also been at work. For example, land ownership patterns have had a role in the development of such recreational and open space facilities as the Pearce Estate to the northeast of the downtown area. Flooding on the other hand was directly responsible for the reversion of Lowery Gardens from a low density residential area to open space.

Vacant Land

Vacant lots tend to show two major concentrations in their distribution. In the first instance they are frequent on the fringe of the central business district where many lots have been cleared to make way for temporary parking facilities. Secondly, some extensive vacant tracts are present in the industrial areas of the southeastern valley



Plate 19. Light industry in the planned Highfield industrial estate.



Plate 20. City Hall complex in east Calgary.

flat. Here they can be particularly related to the marshy areas in the bottom of the former meltwater channels. Also the widespread adoption of the grid iron form of subdivision has rendered some lots on the steep bluffs incapable of development and these remain vacant.

Transportation Facilities

As was seen above, rail facilities are entirely concentrated in the study area. Their role in fashioning commercial and industrial land use has been a recurring theme of this chapter and will also be emphasized in the questionnaire analysis.

Most of the study area is characterised by a rectangular street pattern and only in north Bridgeland and Sunalta has any attention been afforded to contours. This layout has resulted in a lack of traffic segregation in residential areas and an inefficient circulation system near rail tracks and sidings. These characteristics have assisted in the spread of urban and industrial blight around the downtown area and in the older pockets of development east of the Elbow River. It is only in the north that use has been made of the valley to effect rapid east - west transportation. Here Memorial Drive provides a connection along the river from the western extremity of the city to Nose Creek in the east.

CHAPTER IV

INDUSTRIAL QUESTIONNAIRE ANALYSIS

Introduction

From the above discussion it is obvious that industrial development has been affected to a greater extent by the physical nature of the valley than any other element of the land use pattern. The questionnaire approach was, therefore, adopted as a means of obtaining a wide variety of data concerning the role of physiography in industrial location.

In order to test the feasibility of this particular line of research, questionnaires were initially despatched to fifty firms in the valley. The recipients of this sample questionnaire were believed to represent those industries in whose location valley form would have played an important role. Agricultural and petroleum processing plants were typical of the large space using activities at which this questionnaire was generally aimed.

The 50 per cent return suggested the usefulness of the approach as a major line of research. Subsequently, industrial questionnaires were sent to 250 firms in the valley. These were selected on a random number basis from the 316 industries listed in the Manufacturers Directory of the City of Calgary.¹ From this major survey sixty-two forms were completed representing a return of approximately 25 per cent. Altogether, therefore, eighty-seven replies

¹ Manufacturers Directory, City Industrial Development Department, Calgary, 1963, 24 pp.

were available for analysis giving a total return of 29 per cent from both questionnaires.

The higher response to the sample questionnaire would appear to indicate a greater readiness on the part of the more important industries to supply information. This hypothesis is given weight by the fact that, with a few notable exceptions, non-returns were from the smaller type of enterprise.² Replies from the major industries were also more detailed and it was evident that in many cases considerable trouble had been taken to ensure complete coverage of the information requested. Another pleasing trend was the frequent intimation of offers of further assistance from these larger industrialists. Returns were most heavily concentrated in the week after despatch. However, those returned after an appreciable time delay were generally more complete and proved of greater assistance.

Scope of the Questionnaire

Copies of both questionnaires are reproduced as appendices A and B. It is possible to some extent to correlate the replies to both surveys as many of the questions were essentially similar. In the analysis that follows this has been attempted wherever possible. The questions were not identical in all instances, however, for it was frequently found that replies to the sample questionnaire suggested other possible lines of enquiry which were subsequently

² Company policy prevented Calgary Brewing and Malting Co. Ltd. from completing a return.

adopted.

The following themes were used in the compilation of both surveys:

- (1) the importance of the physical characteristics of the study area for site selection,
- (2) the advantages and disadvantages of location in the valley,
- (3) flooding as a past, present and future hazard and restriction on land use,
- (4) the importance of rail transportation and the possible substitution of other forms of transport and,
- (5) the merits of industrial concentration in the valley, bearing in mind access and possible relocation considerations.

RESULTS AND ANALYSIS OF THE SURVEY

Valley Characteristics and Industrial Location

The relative importance of valley characteristics in industrial location is illustrated in Table IV below.

TABLE IV

THE IMPORTANCE OF VALLEY CHARACTERISTICS IN INDUSTRIAL LOCATION
(By Percentage Return)

CHARACTERISTIC	SAMPLE SURVEY	MAJOR SURVEY	COMBINED
Flat land	44	26	31
Water supply	52	22	31
Rail proximity	44	40	41
Surficial materials	16	11	13
Wind direction	4	--	1
Not important	12	46	37
Groundwater	12	10	10

The table immediately indicates the greater importance of considerations of slope and water supply for those industries surveyed in the sample questionnaire. These facts illustrate the nature of this survey which was primarily directed at the heavier industrial establishments as well as those located in close proximity to the Bow River. In contrast, the major survey embraced a much wider range of activity including many firms whose location was not dependent on the physical nature of the study area. This is borne out by the fact that 46 per cent indicated that physical factors were not important in site selection.

It is possible to conclude from the combined reply that considerations of slope and water supply were important criteria in site selection for approximately one-third of all industry. This group comprised the large space and water using activities, such as petroleum refining, brewing and the preparation of construction materials. Availability of flat land was also an important criterion for those industries requiring extensive storage facilities. As both of these factors are more easily attainable in the study area than elsewhere, their effect on the land use pattern is apparent.

The importance of rail facilities proved remarkably constant in both surveys and conveys the impression that this remains a critical factor for many types of industry today. The processing of agricultural and petroleum products as well as the wholesaling of bulky commodities, such as timber,

were enterprises whose locations were most influenced by the provision of rail facilities. These groups also constitute the 8 per cent of the major survey that could not under any circumstances substitute road for rail transport.

The extreme importance of physical factors in the industrial land use pattern is immediately evident when it is remembered that rail location has primarily been a function of physiography. In fact, one return from north Calgary drew attention to the absence, north of the river, of convenient spur trackage.³

Replies to the questions relating to groundwater and surficial deposits were also essentially similar. Here it did not always prove possible to determine whether the influence was positive or negative; for example, whether the presence of groundwater was an advantage, as in the brewing industry, or a disadvantage, as in the mining industry. Generally, industries considering groundwater in their location also paid attention to the nature of local deposits illustrating the high degree of correlation that frequently exists between these two factors. As was seen in Chapter II, groundwater is suitable for some industrial purposes and is extremely important as an industrial coolant in east Calgary. Although many firms examined surficial deposits purely as building foundations, the sand and gravel industry is entirely controlled by their occurrence.

Of all the returns only one listed prevailing winds

³ This firm located in southwest Bridgeland.

as having a role in site selection.⁴ The concentration of industry in southeast Calgary and the fact that the prevailing wind is from a westerly direction suggest that a downwind location is taken as normal or, at least, is a fortunate coincidence.

As was alluded to above, physical factors played no apparent role in the location decision of many industrialists. Of the combined returns, 37 per cent indicated this opinion. These negative answers were generally from the smaller type of service industry such as printing establishments and local bakeries.

Research conducted by Guthrie regarding industrial water demands in Alberta proved of interest to the present discussion as some of the associated questionnaires were returned from industries in Calgary.⁵ Results show that municipal supplies were adequate for industries whose water requirements were small. However, large consumers prefer a location in the study area convenient to river or underground supplies from the local gravel aquifers. Industrial water use in Calgary is generally based on the municipal supply and there is little evidence to suggest that many establishments use water directly from the river. This practice is restricted to the petroleum refining plants and some of the construction industries. Development of private wells has caused a lowering of the water table so that some of the

⁴ The Imperial Oil Company's refinery in Inglewood

⁵ Pers. comm., J. F. Guthrie, Geography Department, University of Alberta, Edmonton, 1964.

older, shallower wells have been depleted. Guthrie's research also indicated that a serious lowering of the water table could be associated with periods of low river discharge such as the winter season.

This research also suggested that few industries discharge effluent directly to the Bow River. Only three instances could be located, all of which were situated east of the Elbow River in southeast Calgary.⁶ Generally, industrial wastes are disposed of through the municipal sewerage system. There is on record, however, one historical case of a meat packing plant disposing effluent into the gravel beds of an old stream channel.⁷ It could not be ascertained if this was a critical site control as the firm in question was established prior to a municipal sewerage network.

The main conclusion to draw, therefore, from this complimentary research is that a direct source of river water is not of great significance in industrial location. Proximity to groundwater supplies would appear to be of much greater importance.

Relative Importance of Physical and Economic Location Controls

Results from the major survey indicate that economic considerations were more important in the general location of industry. Only 3 per cent of the industrialists stated that location in the Calgary area was primarily dependent on physical considerations. While 7 per cent stressed both sets of

⁶ Both oil refineries and a concrete products industry.

⁷ P. Burns and Company Limited.

factors, 80 per cent concluded that economic motives exercised the most significant role in their location.

However, while economic considerations entered into the location decision at a regional level, it may be inferred from the above discussion on physical influences that the latter proved of greater significance in pinpointing the exact site. Their role in establishing the industrial pattern of the city is obviously much greater than the figure of 3 per cent quoted above would suggest.

Generally, it may be stated that industrialists seek the best combination of both sets of factors and, dealing in monetary terms as they have to, would tend to play down the physical side except where adverse site conditions hindered a successful operation. A detailed discussion of the economic location considerations is held over until the section dealing with valley advantages, for in many ways they are essentially similar.

Flooding

Table V below illustrates the importance of flooding as a site control in the study area.

TABLE V
FLOOD HAZARD IN THE STUDY AREA
(By Percentage Return)

ASPECT OF HAZARD	SAMPLE SURVEY	MAJOR SURVEY	COMBINED
Potential problem	24	3	9
Site consideration	32	12	17
Damage experienced	20	3	8

The figures indicate the greater importance of flooding among recipients of the sample questionnaire for these firms were generally located in close proximity to the Bow River. Only a mere 9 per cent of all questionnaires returned denoted that a flood hazard presently exists. However, as was shown above, there remains no adequate guarantee that the flood threat has been diminished and a repetition of the worst flood in the history of Calgary would cause considerable damage to much of the valley flat.

Seven (8 per cent) of all the completed returns stated that flooding has been experienced in the past. Of these, four were due to high backwater stages associated with winter ice jamming and occurred along the south bank near the Bow River channel (see Fig. 7). The remaining three were due to high groundwater levels and may be associated with lowlying areas in or near former stream channels. One return from north Calgary indicated that prior to regulatory measures being employed upstream no flood difficulties had ever been experienced.⁸ Since then, however, they had experienced 'recurring trouble' which lends weight to the concept that a downstream increase in hazard has resulted from the increase in winter discharge associated with the generation of electricity.

However, the fact that 17 per cent of the total return considered the flood hazard prior to establishment

⁸ This firm is located near the Bow River in southwest Bridgeland.

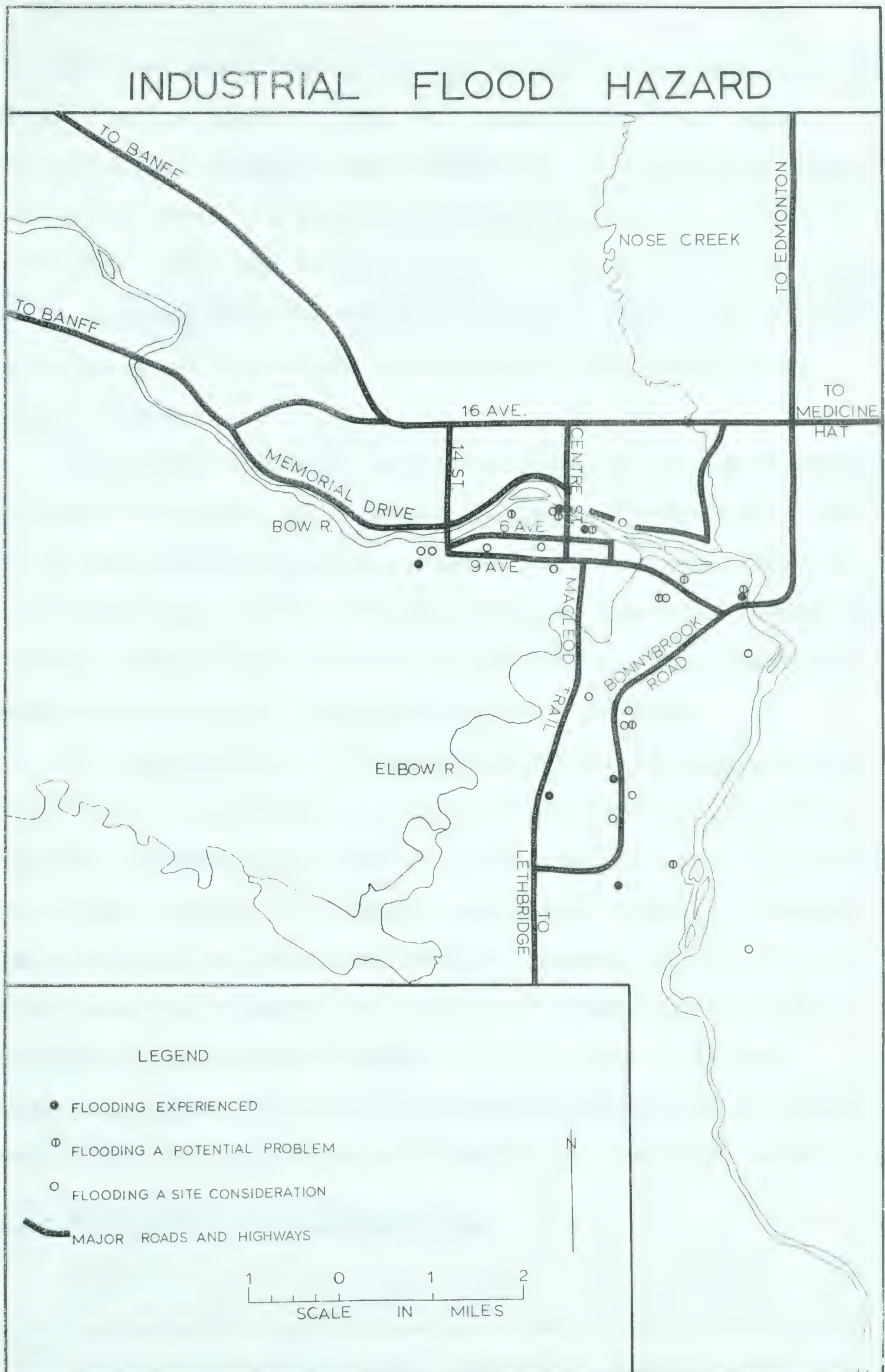


Fig. 7. Source: Industrial Questionnaire

indicates that many industrialists were at least aware of the problem. As is shown by Fig. 7, these returns are widely distributed and suggest that inundation is a potential problem not only near the river channel but over much of the study area. When the locations of all these returns are examined it is seen that the hazard is most acute in the vicinity of the Bow River and along the former stream channels of southeast Calgary.

No return indicated any occurrence of spring flooding. Only one firm seemed to be aware of the major floods at the turn of the century and the implications of a repetition today.⁹ Generally, it was the major, more important industries, as well as those situated on the river bank, that showed the greatest awareness of the existence of a problem.

An examination of Table V would tend to suggest that a flood hazard no longer exists, or that if it does, there is general ignorance and apathy shrouding the issue. In the light of the survey the latter seems more feasible for many industries located near the greatest threat, the Bow River, did not consider flooding at all while others located further afield analysed the hazard in their site decision. Widespread scepticism seems to dominate industrial attitudes towards the whole question of flooding in the study area.

Valley Advantages and Disadvantages

Table VI on the following page illustrates the

⁹ Union Milk Company Ltd. located at First Street and Fifth Avenue Southeast.

relative importance of the major advantages to be derived from a location in the valley.

TABLE VI
VALLEY ADVANTAGES
(By Percentage Return)

ADVANTAGE	IMPORTANCE
Centrality	52
Ease of transport	12
Ease of water supply	8
Proximity to raw materials	28
None	32
No comment	16

The major economic benefits to be derived from a valley location involve its convenience to city-wide markets for local servicing, and to major transportation facilities for regional servicing. As far as the former is concerned, it is important to remember that the central business district lies in the valley and attracts to its periphery many of the small scale manufacturers of convenience and service goods. Most of the 52 per cent indicating that 'centrality' was a major advantage, were located in the central industrial zone although this response was also typical of new industry in the planned industrial estates.

Proximity to raw materials was numerically the second principal benefit. This is obviously of great importance in the construction industry and is tied up with the superficial geology of the study area. Some firms using as raw materials the products of other activities also replied under this heading. Principal among these were the chemical

and petrochemical manufacturing plants using the products of the city's oil refineries.

Ease of transportation and of water supply were important benefits for heavier industry in the study area. The processing of agricultural and mineral products and the manufacturing of building materials comprised most of the positive replies in these categories.

Thirty-two per cent of all the returns indicated that there is no significant advantage in a valley location. These firms, for the most part, have no specific site requirements and their location in the study area seemed to be largely a matter of chance. Answers such as 'emigrated here' and 'born in Calgary' were typical of these small firms and service producing industries.

An indirect advantage of location in the valley lies in the opportunity for closely related enterprises to co-operate for their mutual benefit. Fourteen per cent of the returns to the major survey indicated that extensive benefits were to be derived from a juxtaposition of related enterprises. Many involved the major industrial complexes and their associated trades, for example construction industries were frequently found in association with gravel mining operations. On the other hand, 26 per cent were in no way tied to other enterprises being generally local service industries such as bakeries. The remainder used the products of other industries but proximity to these was not an important site criterion.

Table VII below depicts the principal disadvantages associated with location in the study area.

TABLE VII
VALLEY DISADVANTAGES
(By Percentage Return)

DISADVANTAGE	IMPORTANCE
Inaccessibility	20
Presence of obnoxious industry	4
Proximity to downtown	4
High property values	4
None	56
No comment	20

It will be observed that inaccessibility is by far the most serious difficulty encountered in the valley despite the recent construction of industrial by-passes to east Calgary. Traffic congestion and the absence of such handling facilities as adequate off-street parking and loading, characterise the industrial zone around the central business district. Another source of conflict arises from the dislocation of the street pattern by the complexity of the rail track network in southeast Calgary.

High land and property values are of much greater importance around the downtown area where they frequently have acted as an expansion control on many of the small miscellaneous manufacturing concerns.

The presence of the obnoxious petroleum complex in the southeast renders much of the surrounding land unsuitable to many of the cleaner industries. Southeast Calgary is also too far removed from the downtown area for many

establishments dependent on the trade of the central business district.¹⁰

Alternative Locations

Twenty-eight per cent of all the replies indicated that an equally desirable site could be found elsewhere out of the valley. Generally, this group comprised those industries finding no distinct advantage in the study area. Twenty-four per cent were of the opposite opinion and denoted that such a move would hinder the success of their operation. These were industries such as gravel working, which are undoubtedly tied to the river valley. The remaining 48 per cent refused to comment. It is interesting to note that if relocation was unavoidable then 35 per cent of all the industrialists would favor a move to one of the planned industrial estates. This percentage emphasizes the success of these relatively new developments and not one return contained derogatory statements about them.

Journey to Work

Continued industrial concentration in southeast Calgary should involve more time being spent in the daily journey to work. Recipients of both questionnaires were asked to state the percentage of their employees who travelled longer than twenty-five minutes to their place of work.

¹⁰ One firm manufacturing leather goods in the central zone would favor relocation but considered southeast Calgary was too inaccessible for many of its customers.

The results are tabulated in Table VIII below.

TABLE VIII

DURATION OF THE JOURNEY TO WORK
(By Percentage Return)

Per cent travelling more than 25 mins.	Sample survey	Major Survey	Combined
0 - 20	40	32	34
21 - 40	12	14	14
41 - 60	16	16	16
61 - 80	20	10	13
81 -100	--	10	7

The duration of the journey to work varies with the particular type of industry and the type of employee it involves. Firms in which manual or semi-skilled workers comprised most of the total labor force were not as concerned about the journey to work factor as others, for their employees generally lived near at hand in the residential enclaves of southeast Calgary. Conversely, industrialists requiring a larger white-collar labor force were much more vociferous in condemning the journey to work. The returns of the major newspaper publishing industries were typical examples of this latter group.¹¹

Although some industrialists are beginning to criticise this factor, its seriousness is not of immediate concern. The continued industrial growth of the study area, however, could aggravate the problem and there may exist the need in

¹¹ The Calgary Herald and The Albertan daily newspapers.

the future for an expanded system of ring roads and by-passes.¹²

Industrial Concentration in Southeast Calgary

In conjunction with the above discussion the recipients of the sample questionnaire were asked for their views on the continued development of the study area. An analysis of the returns appears in Table IX below.

TABLE IX
INDUSTRIAL CONCENTRATION IN THE VALLEY

OPINION	PERCENTAGE RETURN
Favorable	52
Long journey to work	8
Growing inaccessibility	4
Expansion difficulties	4
No comment	32

The continued development of the area was overwhelmingly endorsed. Only 16 per cent of the returns contained unfavorable comments and this suggests that, although some firms are experiencing the difficulties enumerated in Table IX, the great majority are happy with present trends. As was seen in Chapter III, the City of Calgary has officially approved this pattern of growth and has encouraged it through its zoning bylaw and industrial estates.

SUMMARY

The most important facts arising from the analysis of

¹² Pers. comm., A. G. Martin, City Planning Department, Calgary, 1963.

the industrial questionnaires are summarised below under the headings 'Valley Advantages' and 'Valley Disadvantages'.

A. VALLEY ADVANTAGES

Fifty-two per cent of all the returns indicated that some locational advantage was present in the study area, 16 per cent contained no comment and the remaining 32 per cent indicated no advantage from such a location. The advantages that were generally enumerated are as follows:

(1) Proximity to the central business district. This fact is important for many of the market orientated industries located in the study area. Proximity to the downtown area is of particular significance to the wholesaling and light manufacturing belt enveloping the business district. Service trades and printing and publishing concerns are typical of industry deriving advantages from a central location.

(2) Ease of access and transportation. Rail facilities are still of immense importance especially for wholesaling and warehousing establishments to the south of the business district. Meat packing, oil refining and the petrochemical industry are also largely dependent on the provision of rail facilities. Access to industrial areas has been improved in recent years with the construction of by-passes and ring arterial roads such as the Alyth bypass and the Glenmore Freeway. Use of the valley for rapid east - west transportation has been accomplished north of the river and tentative plans exist for the construction of a major arterial paralleling the south bank of the Bow River.

(3) Water Supply. Groundwater reserves are excellent in the study area and the quality of the water is suitable for large scale industrial use. Good opportunities also exist for those industries needing large quantities of river water.

(4) Utility systems. The valley flat and the underlying permeable alluvial deposits facilitated the development of the municipal water and sewerage systems. Today these utilities can be easily extended from the existing networks over the entire study area.

(5) Presence of level land. The importance of the valley flat is reflected in the transportation pattern as well as in the existing industrial development. Easy grades have ensured that rail sidings can be provided over much of the area. Today this flat land is suitable for the construction of modern horizontal industrial premises. Large space using industries, such as petroleum refining, find their location requirements can best be satisfied in the valley.

(6) Surficial deposits. The alluvial sands and gravel of the study area provide a porous, well-drained gravel base for construction purposes. They also provide an invaluable source of raw materials and constitute excellent reservoirs for groundwater resources.

(7) Wind direction. The prevailing wind direction ensures that obnoxious gases and solid matter are blown away from the downtown area. The generally clear atmosphere may be of importance for some specialised manufacturing such as cloth and tenting production.

(8) Isolation. This is a factor of immense importance for one industry manufacturing armaments and explosives.¹³ However, as industrial expansion and infilling continue this minor attribute may be lessened and the company expressed concern about the encroachment of other establishments.

(9) Amenity. The general amenity of the entire metropolitan area is enhanced when all the industry, or at least the obnoxious industry, is concentrated in southeast Calgary. Much of the present development remains invisible in the valley when approaching the city by highway.

B. VALLEY DISADVANTAGES

Twenty-four per cent of all the returns indicated that some major disadvantage could be associated with location in the valley. Fifty-six per cent disclosed no disadvantage while 20 per cent contained no comment. These major disadvantages are as follows:

(1) Lack of expansion space. This factor was most important in the zone surrounding the central business district. Elsewhere sufficient land was generally available to accommodate expansion in the foreseeable future.

(2) Traffic congestion and loss of access. Both of these factors are most important around the downtown area where off-street parking and loading facilities are difficult to provide. The adoption of the grid iron street pattern pro-

¹³ Canadian Industries Limited plant in southeast Calgary.

duces circulation difficulties in the vicinity of the rail tracks and on the steep valley sides. Due to the distance from downtown, southeast Calgary does not favor the establishment of industries dependent on the 'walk-in' type of trade.

(3) The journey to work. Despite the existing ring roads and industrial by-pass routes, some dissatisfaction was expressed concerning the distance and time required for employees to reach their place of work. However, this factor is not a serious disadvantage to industry in the valley especially for those firms drawing most of their labor force from nearby residential districts.

(4) The Canadian Pacific Redevelopment Project.¹⁴ The proposal to relocate the main line railway track along the south bank of the Bow River would necessitate some relocation of industry from the central district. Some of the industrialists near the proposed location of the tracks expressed concern at the project: one, wishing to remain anonymous, went so far as to state that 'in view of the plan we would not go on record as answering any of the questionnaire.' This quote sums up the general air of uneasiness prevalent among many industries in the vicinity of the proposed redevelopment.

(5) Industrial concentration in the river valley. Only the industry manufacturing explosives and armaments, noted above,

¹⁴ This tentative agreement between the Canadian Pacific Railway Company and the City of Calgary relating to the proposed relocation of the Company's rail tracks has fallen through at the time of writing.

was strongly opposed to continued development in the valley.

(6) In the older industrial areas around the business district the following general criticisms were frequent; small industrial premises, obsolescent buildings, parking difficulties and high land values and taxes.

CHAPTER V

CONCLUSIONS

It can generally be concluded that the physical nature of the Bow River valley has been of significance in the evolution of the land use pattern. Urban development is commonly dependent on the satisfaction of the following conditions: a suitable slope; abundant space; the ease of water supply and of waste disposal; and the ease of transportation. The occurrence of all these factors in association has made the Bow valley more suited to urban development than any other area within the present municipal boundaries of Calgary. Pressure to develop the benchlands above the river valley did not exist until the 1920s.

The purely physical characteristics of the study area, however, have not been as influential on land use as has the location of railway facilities, in which the role of physiography has been strongly experienced. The relationship between rail transportation and urban development has been the most important factor in the fashioning of land use in the study area. It is essentially in the railway network that the link is found between the physical nature of the river valley and the land use pattern.

Although those land uses most characteristic of the valley can be found elsewhere within the city, they are essentially concentrated in the study area. These characteristic land uses are industry; recreation and open space;

key transportation facilities; and commercial development. The distribution of other land uses in the study area bears little relationship to the physical characteristics of the valley. On a city-wide basis, however, residential development has been greatly dependent on the availability of the essential utility systems which are largely controlled by physiographical considerations. The importance of physical factors in the evolution of these distinctive uses is discussed below.

Slope

The extreme importance of this factor in the evolution of the present land use structure lies in its role in dictating the location of the railway network. Proximity to rail transportation facilities has, in the past, been of immense significance for many industrial and wholesaling premises. The agricultural and petroleum processing industries, as well as others involving the movement of bulky commodities, are situated within easy range of rail facilities. Despite the increasing popularity of trucking in some light industrial and wholesaling activities, the questionnaire survey proved that the provision of rail transportation is still of vital importance for many industries. The industrial pattern also reflects the ease of spur line construction in the southeastern area of the city over the extensive valley flats. These flats are also suited to the construction of modern warehouses and industrial premises. The appearance of the zone of warehousing

and wholesaling along the tracks to the south of the central business district was also directly dependent on the transportation pattern and grew up around the Canadian Pacific Company's terminal facilities in Section 15 on Company owned land.

Slope has also played an important role in the distribution of recreational and open space facilities. Over much of the study area the limiting valley bluffs are too steep to be built upon and these areas have been left as open space. They provide a valuable addition to the recreational resources of the city.

Water Supply

Research has shown that industrial location in the valley for the purpose of taking water directly from the river has not been of major significance in the establishment of the land use pattern. Although some large water-using industries, such as petroleum refining, do use river water this has not been an important site requirement.

Ease of groundwater supply is another characteristic of the river valley which, although it has proved advantageous, is not of primary significance in the evolution of the industrial pattern.

The valley area has been easily serviced from municipal water sources and this has been of significance in the phasing of urban development. The study area was largely developed before the higher benchlands which were difficult

to service and required costly pumping of water supplies. The physical nature of the Calgary area therefore, explains the initial restriction of urban development to the valley of the Bow River.

Surficial Materials

The nature of the surficial deposits has played a contributing role in the evolution of urban land use. The permeable sand and gravel deposits facilitated early construction by permitting rapid disposal of wastes prior to the installation of a municipal sewerage network. The gravels also provided a reliable groundwater supply for early industrial and domestic needs and are still an important source of industrial coolants in east Calgary. However, the only industrial activity that is entirely controlled in its location by surficial geology is the sand and gravel excavation industry. This, in turn, has tended to attract the manufacturers of construction materials since it is costly to transport bulky raw materials. Of wider significance is the fact that the sands and gravels of the study area have constituted sound building foundations for general urban development.

Flooding

Little evidence was unearthed to suggest that flooding recently has acted as a widespread deterrent to urban growth. The only incidence was Lowery Gardens where a change in use from low intensity residential development to open space was in-

volved. However, extensive areas in the vicinity of the Bow River channel remain vacant and may testify that some hazard has been recognized.

Although there is little evidence to suggest that a repetition of the major floods in the history of Calgary is impossible, widespread ignorance and apathy surround the flood hazard question. However, it is encouraging to note that the City of Calgary has recently been examining the flood hazard question afresh in the light of such recent proposals as the Canadian Pacific Redevelopment Project.¹

Slope Instability

Although slope instability can be considered a potential problem along much of the steeper valley bluff, this factor has had only limited significance for the distribution of urban land use. The danger of landsliding combined with the steep gradients has ensured that much of the bluff area has remained as recreational open space.

Air Pollution

It may be concluded that air pollution has not been important in the location of any of the major land use elements. Although some industrialists manufacturing cloth and clothing are becoming aware of the problem, atmospheric pollution is not of major concern today.

¹ Pers. comm., A. G. Martin, Calgary, 1964.

Questionnaires

Of all the elements of the land use structure, the industrial pattern has been most affected by the physical nature of the study area. The questionnaire analysis showed, however, that few industries owe their location primarily to physical factors. The processing of sand and gravel and petroleum refining are the principal industries dependent on the physical nature of the study area.

The survey indicates that it is the presence of a combination of advantages rather than one single element of the physical environment that has been of most significance in industrial location. When these physical advantages are linked to the presence of railway facilities and to the accessibility of the urban market, the study area becomes a choice industrial location for all except those activities geared to road transportation and local servicing.

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APPENDIX A

SAMPLE INDUSTRIAL QUESTIONNAIRE

1. Name of firm _____
2. A. Your firm is (please tick) (i) heavy industry _____
(ii) light industry _____
(iii) manufacturing _____
(iv) non-manufacturing _____
B. What was your basis of selection? (Raw materials -
machinery perhaps). _____

3. In the original site requirements what role did the
following play and why? (If none, write none.)
(i) Flat land _____
(ii) Water supply _____
(iii) Proximity to railway _____

(iv) Groundwater levels _____

(v) Soil or surface materials _____

4. What other, if any, site requirements were taken into
consideration?

- 2 -

5. Do you consider flooding to be a potential problem?_____
- _____
6. A. Have you ever experienced flooding due to stream overbank flow or high groundwater?_____
- _____
- B. Were topics in (6) considered at all in site selection?_____
- _____
7. What in your opinion are the main advantages (physical and commercial)to be derived from a valley site?_____
- _____
8. A. Could these be obtained elsewhere in Calgary out of the valley?_____
- B. If not, why not?_____
- _____
9. Any disadvantages in your present location?_____
- _____
- _____
10. A. If your firm is serviced primarily by rail, could not road transport be substituted?_____
- _____
- B. If not, why not?_____
- _____
- _____
11. Please state approximate number of employees_____
12. Could you estimate approximately what % have a considerable journey to work? (Say 25-30 minutes.)_____

- 3 -

13. What are your opinions regarding the continued concentration of industry in S. E. Calgary?_____

14. Do you have any other comments you believe relevant to this study?_____

APPENDIX B
INDUSTRIAL QUESTIONNAIRE

1. Name of firm _____
2. Your firm is (please tick) Main Product(s)

(a) Manufacturing _____	1. _____
(b) Non-manufacturing _____	2. _____
(c) Processing _____	3. _____
(d) Other (specify) _____	4. _____
3. Why did you locate in the Calgary area? _____

4. In your exact site requirements what role did the following play and why? (If none, write none)
 - (i) Flat land _____
 - (ii) Water supply _____
 - (iii) Proximity to railway _____
 - (iv) Groundwater levels _____
 - (v) Soil or surface materials _____
 - (vi) Prevailing winds _____
 - (vii) Other _____
5. (a) In your opinion did economic factors play more in your decision to locate than physical factors? _____

- (b) Please list economic site controls in order of priority:
 1. _____
 2. _____
 3. _____
 4. _____
6. (a) Do you consider flooding to be a potential problem?

- (b) If so, please give details _____

- 2 -

7. (a) Have you ever experienced flooding due to stream overbank flow or high groundwater? _____
(b) If so, when? _____
(c) Dollar damage estimate? _____
8. Was the flood hazard factor considered at all in site selection? _____
9. In your opinion what are the main advantages (physical and commercial) to be derived from a valley site? _____

10. (a) Could these be achieved elsewhere in Calgary out of the valley? _____
(b) If not, why not? _____
11. Any disadvantages in your location now or in the future? _____

12. (a) If your firm is serviced primarily by rail, could not road transport be substituted? _____
(b) If not, why not? _____
13. Please state approximate number of employees _____
14. What percentage have a considerable journey to work? (say 25 - 30 minutes) _____
15. Please comment on the continued concentration of industry in S.E. Calgary (e.g. perhaps, too long a journey to work, increasing inaccessibility to local consumers, etc.) _____
16. If re-siting would you have considered the new planned industrial estates? _____
17. (a) Do you use the products of other industries? _____
(b) Was proximity to these important in site selection? (Tick) YES _____ NO _____.
18. Finally, do you have adequate physical room to expand in the future? _____





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